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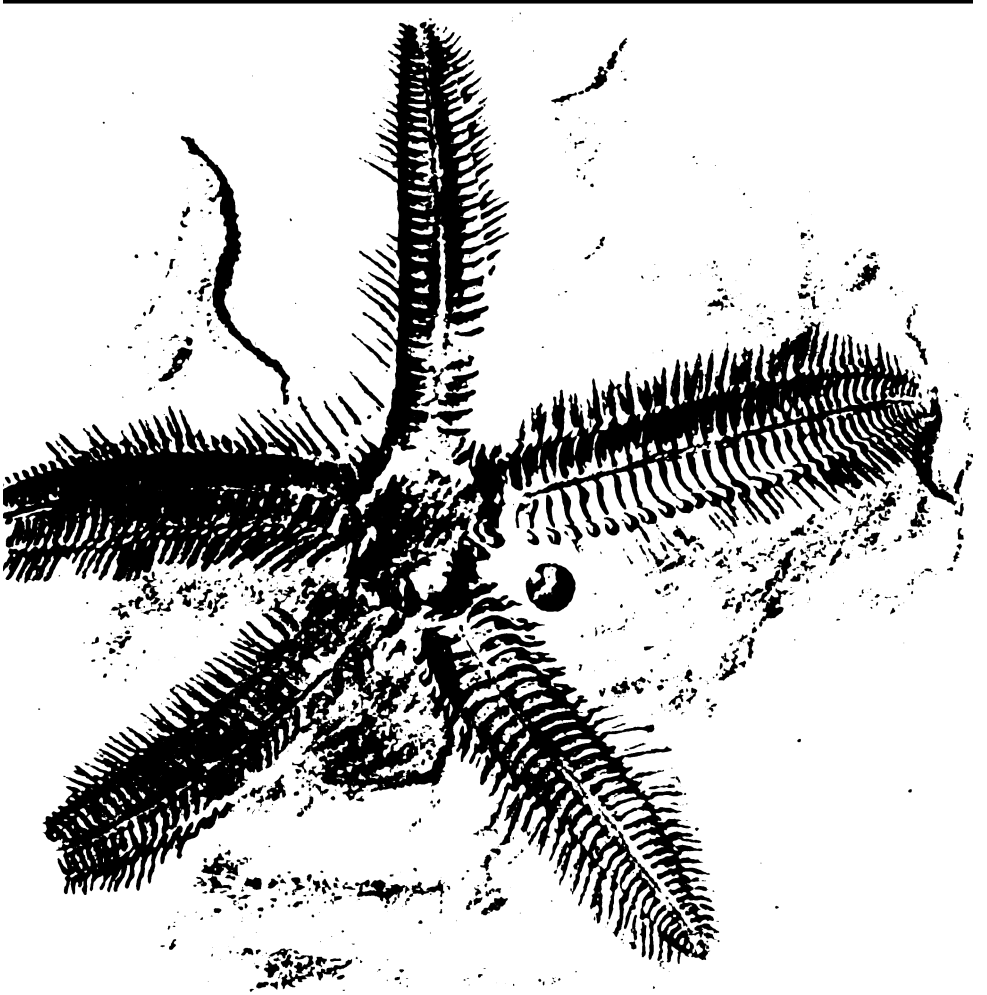
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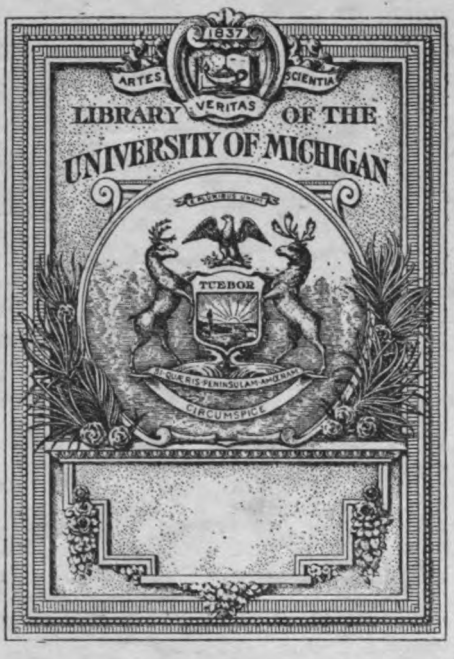
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New York State Museum

JOHN M. CLARKE, Director

Museum Bulletin 164

NINTH REPORT OF THE DIRECTOR OF THE SCIENCE DIVISION

INCLUDING THE

66th REPORT OF THE STATE MUSEUM, THE 32d REPORT OF THE STATE GEOLOGIST, AND THE REPORT OF THE STATE PALEONTOLOGIST FOR 1912

		PAGE
Introduction		5
I	The State Museum law	6
	The Statutory Conception of a "State Museum"	6
	The State Museum idea and its place in the polity of the State	7
II	The educational function of the State Museum of Science	9
III	Condition of the scientific collections	15
IV	Report on the geological survey	16
	Areal geology	16
	Surficial geology	21
	Industrial geology	25
	Seismologic station	28
	Paleontology	30
V	Report of the State Botanist	33
VI	Report of the State Entomologist	35
VII	Report of the Zoologist	43
	Monograph of the New York Mollusca	44
VIII	Report of the Archeologist	45
	Archeological survey	45
	The O. W. Auringer collection	47
	Archeological collections	54
	Folklore	56
	Public interest	57
IX	Publications	57
X	Staff of the Science Division and State Museum	62
XI	Accessions	63
The Mount Morris Meteorite. H. P. WHITLOCK		78
Early Paleozoic Physiography of the Southern Adirondacks. W. J. MILLER		80
The Garnet Deposits of Warren County, New York. W. J. MILLER		95
The Use of the Stereogram in Paleobiology. G. H. HUDSON		103
The Origin of the Gulf of St Lawrence. J. M. CLARKE		132
A Notable Trilobite from the Percé Rock. J. M. CLARKE		138
Illustrations of the Devonic Fossils of Southern Brazil and the Falkland Islands. J. M. CLARKE		140
Index		211

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1913

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(July 15, 1913)

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New York State Education Department
Science Division, February 13, 1913

Hon. Andrew S. Draper LL.D.
Commissioner of Education

SIR: I have the honor to transmit herewith the manuscript and accompanying illustrations of the annual report of the Director of the Science Division, for the fiscal year ending September 30, 1912, and I recommend the same for publication as a bulletin of the State Museum.

Very respectfully
JOHN M. CLARKE
Director

STATE OF NEW YORK
EDUCATION DEPARTMENT
COMMISSIONER'S ROOM

Approved for publication this 19th day of February 1913

Commissioner of Education

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New York State Museum

JOHN M. CLARKE, Director

Museum Bulletin 164

NINTH REPORT OF THE DIRECTOR OF THE SCIENCE DIVISION

INCLUDING THE

66th REPORT OF THE STATE MUSEUM, THE 32d REPORT OF THE STATE GEOLOGIST, AND THE REPORT OF THE STATE PALEONTOLOGIST FOR 1912

INTRODUCTION

This report covers all divisions of the scientific work under the charge of the Education Department and concerns the progress made therein during the fiscal year 1911–12. It constitutes the 66th annual report of the State Museum and is introductory to all the scientific memoirs, bulletins and other publications issued from this office during the year mentioned.

Under the action of the Regents of the University (April 26, 1904) the work of the Science Division is "under the immediate supervision of the Commissioner of Education," and the advisory committee of the Board of Regents of the University having the affairs of this division in charge are the Honorables: Daniel Beach LL.D., Watkins; Lucius N. Littauer B.A., Gloversville; Adelbert Moot, Buffalo.

The subjects to be presented in this report are considered under the following chapters:

I State Museum Law
II The Educational Function of the State Museum of Science
III Condition of the Scientific Collections
IV Report on the Geological Survey
V Report of the State Botanist

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VI Report of the State Entomologist
VII Report on the Zoology Section
VIII Report on the Archeology Section
IX Publications of the year
X Staff of the Science Division and State Museum
XI Accessions to the Collections
XII Appendixes (to be continued in subsequent volumes). All the scientific publications of the year.

I

THE STATE MUSEUM LAW

The present attitude of the State of New York toward its museum is defined in the statute enacted in 1889 and incorporated without change in the codified Education Law of 1910:

All scientific specimens and collections, works of art, objects of historic interest and similar property appropriate to a general museum, if owned by the State and not placed in other custody by a special law, shall constitute the State Museum.

This provision for the existence of a State Museum is brief and precise, but the conception which lies behind it is broad, enlightened and efficient. Provision is made, not alone for a museum of science, even though to the present day the science museum only has received recognition and support by actual allotments from the Legislature. The law is broader than the present exercise of that law and the genius of the brief enactment cited rises above the actual condition attained by virtue of it.

THE STATUTORY CONCEPTION OF A "STATE MUSEUM"

The letter and evident spirit of the law provide not only for the museum that now exists, but for any public museum which the people of the State may choose to bring into existence, whether it be a museum of history, of art, of industry, or of education; and all such museums and their materials shall constitute the *State Museum*. The statute clearly opens the way for the institution, at the will of the people, of a series of museums or departments of a State Museum, as many in number and nature as the reasonable demands of a populous, wealthy and intellectual state may regard essential to the instruction of its people. No law for the establishment of public museums could be broader in import or susceptible of a more generous interpretation in strict accord with the expressed wishes of the people. It is the deliberate expression

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of the Legislature of the State that a place be provided in its polity, not alone for the museum of science, which has been in existence for sixty years, but for additional museums, as their need may become appreciated, all under the control of the Education Department. This is clearly the meaning of a law which, in state legislation on this subject, is not surpassed for conciseness and breadth.

THE STATE MUSEUM IDEA AND ITS PLACE IN THE POLITY OF THE STATE

This State has thus far developed its magnanimous conception of the *Museum* only along the line of science. So far as it has gone it has doubtless done well in this single direction, for its museum of science has brought credit to it and to those who have shared in its development. The State Museum of Natural History has achieved a distinctive and worthy repute among such scientific museums whose interests are of necessity somewhat restricted by political boundary lines. It is very doubtful if any state museum of science should attempt to enter the wider field of the world and thus compete with the great privately endowed museums of the larger municipalities. Its function is well and adequately defined in portraying in fulness the natural resources of its state. The good repute of the New York State Museum of science has come, however, more from the work of original research which it has fostered, than from the educational service thus far rendered through its collections. These collections have been assembled very largely for the service of the investigations, rather than with the purpose of elucidating to the people the significance of these researches. So far is this the case that the science museum, now entering a new building with capacious and well-equipped halls, finds itself deficient, not in the quantity but in the quality of scientific materials suitable to display to the public or competent lucidly to explain the facts they represent and the researches which the Museum has prosecuted. This is a condition which must be remedied if this Museum is to become a vigorous arm of the educational service. In a very real sense the science museum, notwithstanding its long history and its large collections, is beginning anew, for never within its history has it possessed a satisfactory *locus*. Its collections have long been scattered through many different buildings. But out of the assembled material now brought together in the Museum halls of the Education Building, is to develop a series of scientific collections in the various departments of natural history

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here pursued, that will be of effective instructional value entirely creditable to the State.

That a knowledge of a state's natural resources is of paramount moment to the people, needs no argument. That the people should have an insight into the larger scientific problems based upon and arising from these natural resources, will not admit of debate. In the natural and orderly development of practical and intellectual interest among the people, these are demands which have a superior force because they develop first.

But this great Commonwealth has certainly reached a stage of intellectual attainment where it may demand now, or should demand soon, the development of the fuller conception of the additional museums to which the statute has pointed the way. The State of New York has no museum of its own history. Whether it should have is not a matter for debate. The director's project for such a museum has been approved by the Commissioner of Education, by a special committee of the Board of Regents, by unanimous vote of the Board itself, by the finance committee of the Senate and by a thousand expressed opinions of competent citizens. Yet it does not exist. The substantial means fail largely because a *locus* for such a museum still fails. The hope that the Education Building might accommodate such a museum probably must be abandoned for want of room, and until there is a definite answer to the question " Where are you going to put it? " the appropriations necessary for its creation will be withheld. For such an historical museum public sentiment is ripe, and the time is ripe. In the impending amplification of the State's buildings provision should be made for it.

Have the people of the State of New York reached a stage of such intelligent concern in their past as to desire a portrayal of the development of the industries on which their wealth and happiness so largely depend? Has not the time arrived when a museum which would teach the people how the raw material in every line of industry is evolved into the finished product, would have a very distinctive usefulness to all the people? How many among the ten million citizens of New York know that their morning newspaper requires in its manufacture the use of sulfur and lime, and talc or clay as well as wood? One who is concerned with modern methods of any manufacture will be as much concerned in the historical development of that industry. Here lies an immense field of deepest concern and very high instructional value. To such an inspiring institution as a museum of industry, all paths would lead; the direct

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appeal to the people would be of tremendous force and the response from the people would not fail to be substantial. It is well worth while to consider if the development of this conception in the museum series can wisely be left to a coming generation.

The public art museum is naturally the last to take its place in the development of the public museum idea. Time will bring it to every state as intellectual appreciation and the love of the beautiful advance. Experience has taught this, and the abundance of art museums maintained in the older countries by state grants is evidence that, even though the time may still be unripe in New York, at least its seed has taken root.

A law in which the people have intimated a desire, if not an intention, to develop the museum idea for the State on the broad lines indicated, remains but partially enforced. An intelligent people opened the door for the development of this idea; the conception has been rather too long left unheeded. This State has intimated its willingness to stand for the progressive habilitation of this conception and with the Regents of the University, charged with the enforcement of this law and the right to execute its intentions, lies here an opportunity for additional public service.

II

THE EDUCATIONAL FUNCTION OF THE STATE MUSEUM OF SCIENCE

In rendering the annual account of the procedure in this division during the fiscal year, it seems well to ask special attention from those who may read this report to the requirements of the real educational functions of this organization. Year after year record has been made of the advance of work along the several lines of scientific inquiry and conversation legitimately pursued by it. Data of scientific worth and moment have annually heaped up on the vast accumulation of like facts which the many years of previous work have brought forth; publications have issued in unbroken streams, in which some part of this accumulation of knowledge has been digested and set forth so as to take its proper place in the fabric of science. All the work done and the work begun, whatever its outcome, is to have its final bearing on the progress of the knowledge of this State and its natural resources, howsoever remote its immediate relation thereto may seem.

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Not for an instant has the attitude of the chief educational officer, judicially reflecting the underlying sentiment of the State, intimated a purpose to restrain or curtail investigations in those lines of pure and applied science here carried on; on the contrary this influence has substantially favored and appreciatively encouraged all this work, in geology, paleontology, mineralogy, botany, entomology, zoology and archeology; the proper fields of science which this division covers. Such indeed has been the historic attitude of the State toward this work and such without question it is likely to be.

This Division of Science, during its long existence of seventy-five years, has rolled up a monumental record of the varied scientific resources of the State, embodying facts and factors which have modified and added to the total body of science in ways that it would now be difficult to estimate. The State of New York has become classic ground of these scientific branches and its fund of records is in keeping with the vastness of its natural wealth. There could be no justification for any cessation in these activities, whether they pertain to pure or to applied science. The mining production of this State has increased by 3000 per cent since the inception of the Geological Survey. The control of insect depredations upon the agricultural and forest crops of the State becomes annually of greater moment to the people with the yearly enlargement of the crops themselves. The conservation of all our native fauna and flora is a problem of growing concern.

These are but items in the progress of results, but it may be said with security that never in its history has this division been of more immediate usefulness to the progress of the people nor its contributions in pure science of more moment to the philosophy of life. The solution of every problem of science brings with it new and larger problems. The bell never rings on scientific progress and research — if it does, in a State like this, it is a knell that tolls for death and decay. There lie before us today in these various fields of research larger problems, more deeply fraught with the welfare of the Commonwealth, more intimately concerned with the inspiration and uplift of the citizen, than there have ever been.

But in an evident and pregnant sense we have now come to a turn in the road. This division is, and has long and properly been, a part in the University of the State and the Department

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of Education; and as such its ideals of research have never faltered or been contravened. Now, by virtue of the equipment for it of extensive museum halls, it enters by force and by preference into more immediate and direct touch with the citizens. The burden is laid upon it to bring home to the people, by visual appeal, the meaning of all that has been said and done in science during the years past. The "State Museum" has long been a statutory designation, intimating scientific collections brought together for the exposition of our natural resources but in reality implying and covering the investigations of these resources themselves. At no time in the history of the organization has there been an adequate museum; not once in all its career have the people been able to come into actual touch with the materials on which the published scientific works have been founded or to learn through their own eyes the real meaning of the resources and of the operations of nature which have been portrayed on the thousands of pages and plates of our public reports.

The fact that this time has now arrived, that capacious quarters are about to be fully equipped for the reception of the material objects of science, brings, in effect, a new function to this division — that of making an efficacious and impressive contribution to the education of the people into these sources of knowledge, in a building devoted throughout to the official diffusion of knowledge.

There are certain aspects of this new function that are proper in this public report at a time when the equipment of this museum of science lies just a step ahead. The first of these, first in significance to those on whom this large duty devolves, is the fact that thus far the Museum has been the repository of the materials brought together by men engaged in the solution of scientific problems; these materials are not in any large sense conspicuous objects, carefully selected for special purposes of display, or to tell their own story. The collections of the Museum are very large, as state museums go, but if this large amount of material now contained in thousands of boxes, drawers and cases, were to be so divided that one part should comprise all that would arouse the interests of the inexpert, the latter would be but a slender fraction of the whole.

In the science of paleontology, a science of which the State of New York has for years been the especial patron, this fact is preeminently true. The Museum resources herein are large, but of this large accumulation there is only a small part that can be

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made to tell its fascinating story to the uninitiated. To consider for a moment the demands of this science alone, and its place in a museum: the people of the State have a right to know what it is all about and why such extraordinary encouragement has been given to its prosecution; how it is that the State of New York has acquired its repute as the exponent of this science, and, if it is true that more is known of the paleontology of this State than of any equal area of the world (as has been said by a distinguished French geologist), where is the proof of this outside of published documents. There are no mysteries in science and the fruits of this knowledge are the property of the people who have paid for it. There is thus laid upon this division the acquisition of materials in this field of science, that will tell the story of the life in the seas and on the lands of ancient New York, its beginning, its development and its outcome, and tell it in a way so lucid and intelligible that the visitor to the Museum can read it and learn it. No good thing, therefore, that can make clearer the wonderful history of life in this part of our ancient earth, and so help to enforce the broader lessons of the life from which we have derived our own existence, can be sacrificed or neglected, for so simply gross a reason as that appropriations for this work are inadequate. A scientific specimen in a labratory and such a specimen in a museum are of two vastly unlike qualities. The one tells its story to the expert, the other must be made to tell its simple and clear story to the larger world.

What has thus been intimated with reference to this science of paleontology may be said with equal appropriateness of all cognate sciences. Each has its meaning as a factor in the education of all the people.

It is to this factor that the State Museum must now address itself. In so doing, to effect the real educational purpose of this Museum, to bring into sympathetic play with the scientific purpose of the organization the natural interests of the people in the works of nature, to meet this enlarged opportunity for service, substantial aid must be afforded.

A half million citizens of this State visit the seat of government every year, some on business and some on pleasure, and the capital, among its other attractions, is now to present to them a public museum — the museum of the people themselves. It is needless to speculate as to what percentage of visitors will direct their footsteps to this place. It is not the purpose of the

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administration of the State Museum to offer to the visiting public a show of "curios," or a series of discrete and incongruous objects without rationale or consecuity. It is its purpose to bring through the public eye into the public heart the concerns of the natural resources of the State; the stories they tell, the business they record, the possibilities of commercial development they carry, the welfare and protection of the life that constitutes our native fauna and flora; to portray the development of the State from the beginning of its geography and with it to depict the course of its life through prehistoric stages up to the day of our aborigines with their multifold activities and culture; and so into the border lands of actual history.

Enough has been intimated in the foregoing in regard to the educational purpose of the State Museum of Science to make way for the conclusion that such functions can not be realized without a liberal support from an intelligent community. The State of New York can make what it will of its Museum — a storehouse of scientifically important but educationally arid facts, or a conservatory of inspiring and uplifting knowledge of its natural resources. To elect the latter as a deliberate policy of the Education Department is of necessity to supply the Education Department with the requisite funds to do it. It is in all respects a question of funds, for neither competent and enthusiastic men nor adequate materials are wanting for such an end.

It is therefore most proper at this juncture in the history of the organization to direct public attention to these requirements if the real purpose of the State Museum is to be assured.

Though it has been the practice of the State heretofore to encourage these several lines of scientific research, it has not been its practice to give hearty support to the development of its Museum. The State Museum as a depository of natural resources has been rather tolerated than espoused. Its collections have come to it incidental to other activities rather than purposely and for definite educational ends. The State Museum does not compete with the great civic but privately supported museums of this country and this day. Its field is not the world, but the State of New York. It should not attempt to exploit the world for its materials or for its educational purposes, but it should exploit the State of New York to its utmost, in order to set before the citizens of the State a conception of its natural resources and of the large scientific problems arising with them.

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Conceding that its field is wisely restricted to the boundaries of the State, the State Museum should certainly have just as generous and substantial aid as is so freely given today to the private museum by the private patron. It is not enough for New York merely to recognize the fact that the State Museum exists simply because other states have created and recognize their museums. Nothing is enough for the proper pride of the State and its citizens except that this Museum shall be of the best and an effective arm of the educational service. It is not enough that the State Museum shall attempt to exercise its proper function with only the materials which may properly be designated as the accessories of its scientific researches. Nothing less than the best the State has is good enough for its people, and to permit this Museum to impart its instruction with less than the best, is to affront the people. The Museum of the people of this State should be of such quality as will bring credit to a State which has established a pioneer record for effective scientific research.

An illustration here is in point and immediate. The reportrayal of the life and culture of our aborigines, the Iroquois Confederacy, is one of the living functions of the Museum. In the Capitol fire a large part of the historic Indian collections were destroyed, some ten thousand specimens. The loss must be made good, so far as it is possible to do it. Time quickly wipes out records of the past. The Indian relics which were so common and perhaps so little valued in our boyhood are becoming scarce. The Iroquois Confederacy belonged to the State of New York and is a momentous factor in its history; it stood between the French and English cultures on this continent and kept the United States and Canada from becoming colonies of France. Every relic of this ancient culture now left among the citizens or in the soil should become the property of the State and that too as quickly as possible. These relics are records as valuable as books, and the generations to follow us will justly pass condemnation if we allow them to pass into obscurity and forgetfulness.

Moreover the State Museum should be recognized as the State's single and proper depository of scientific natural objects. The people should understand that here is where they may come for all information upon the natural products of the State. It is bootless and confusing for the State to maintain a collection of scientific objects in Letchworth Park on the Genesee

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river, a few casefuls of birds and fishes in connection with one administrative department, and perchance of seeds and soils with another. Museums require today a high grade of technical service for the proper conservation of these materials. Such minor side efforts soon degenerate from lack of proper and intelligent care and involve an expenditure of public money for no good purpose.

Notwithstanding the support which has long been given to the work of the State Museum, its light has been too much under a bushel, it has had too much of the closet, has been too esoteric perhaps in its indifference to public appreciation. Its influence should reach to all the people. Yet it is well to record here the fact that a long and distinguished body of citizens have personally given their indorsement and support to its work; as witness the five hundred members of the New York State Museum Association, men of influence and distinction in all sections of the State.

III

CONDITION OF THE SCIENTIFIC COLLECTIONS

During the fiscal year some part of the usual field operations of the staff of the Science Division has been curtailed in order to meet the additional expense thrust upon the division by the operations preliminary to removal of the scientific materials to their new quarters. At the date of this report actual removal has not commenced, but lies in the immediate future and the actual condition of the collections is now such that their transportation can be effected without delay or damage. Further than this, it has seemed wise to utilize the opportunity and some part of the available financial resources of the Museum to prepare and complete special objects and groups of objects of conspicuous worth and interest for prompt and ready display. These preliminary preparations have not been inexpensive. They have involved the dismembering and packing of large skeletons such as the whale, the mastodon, the elephant, the Irish elk and the entire series of lesser skeletons which could not be transported in their mounted condition. They have further involved the preparation of series of large models in plaster of especially noteworthy objects; and very particular packing of the State's extensive collection of birds and so on through the more delicate materials pertaining to the Museum. Provision has been made by

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the Legislature for the construction of cases for all the Museum collections on specifications which will make them of most modern type. This fine equipment will permit the Museum to leave behind it the antiquated and uninviting cases which pertain to its past career. The planning for this equipment has involved close and arduous study and has called for the continued attention of the members of the staff.

Notwithstanding these immediate internal duties of the division the lines of scientific research which properly pertain to it have been forwarded along their usual channels. The subjects which have engrossed the attention of the members of the staff have been somewhat diverse in character. The mineral springs at Saratoga have been the subject of close investigation as to their origin and an elaborate report thereupon has been issued. The study of the geographical development of the State has reached a point at which it has been possible to issue during the year a series of maps indicating the condition of New York at various stages during the period of retreat of the great ice sheet. The mineral industry of the State has received special attention and lines of possible future development of this industry have been indicated in the annual report on the mining and quarry industry. It is a part of the business of the State Geologist to execute a geological map of the State and this work has been in progress for a number of years, the base of the map being on a scale of one mile to the inch. This work has made a decided advance during the last year and the area of the State covered in this very great detail now approaches 20,000 square miles. Probably in no state has the plotting of its geology been carried on so minutely over so large an area. Of special interest also has been the work of the State Entomologist in his efforts to control the depredation of the many insect pests that are damaging the agricultural and native forest crops of the State. In this line this official has been very diligently occupied and with advantageous results.

IV

REPORT ON THE GEOLOGICAL SURVEY

AREAL GEOLOGY

In recent reports, statements have been made in regard to the progress of the areal mapping of the State on the topographic base map. During the past year, the additional quadrangles completed in western New York are those of Brockport, Hamlin,

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Albion and Oak Orchard. Preliminary control has also been made in the Medina and Ridgeway quadrangles. Reports with maps have been rendered in final form on the following quadrangles: Attica, Depew, Caledonia, Batavia, Eden, Silver Creek; the Phelps quadrangle is also essentially complete.

For this entire western New York region the present condition of the areal survey for the geologic map may be thus summarized:

Quadrangles published:

Auburn	Honeoye	Penn Yan
Buffalo	Naples	Portage
Canandaigua	Nunda	Tully
Elmira	Olean	Watkins
Genoa	Ontario Beach	Wayland
Hammondsport	Ovid	

Quadrangles reported:

Albion	Caledonia	Oak Orchard
Attica	Depew	Phelps
Batavia	Eden	Silver Creek
Brockport	Hamlin	

Quadrangles mapped:

Cherry Creek	Dunkirk	Westfield

Quadrangles begun:

Bath	Medina	Ridgeway

In northern New York a completed report on the North Creek quadrangle awaits publication. In the last field season, the Lake Pleasant quadrangle was surveyed by W. J. Miller, who reports that the prevailing rocks belong to the syenite-granite series and comprise syenite (augitic to hornblendic), granitic syenite, granite and porphyry. These rocks show all sorts of gradations from one type to another. Grenville gneisses, in areas sufficiently free from igneous rocks to permit separate mapping, are present in very subordinate amount. Grenville limestone is unusually scarce, only a few small outcrops having been noted.

Still other areas, often of considerable size, are made up of very closely involved syenite or granite and Grenville. Many

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times the evidence seems conclusive that Grenville gneisses have been melted and actually assimilated by the molten intrusions so that various rocks of intermediate character have resulted.

Only a few diabase and gabbro dikes have been found. Several of the diabase dikes are distinctly porphyritic with large plagioclase crystals, but the exact nature of these rocks has not yet been determined.

The chief geologic interest of the quadrangle centers about the valley at Wells because of the location there of the important outlier of Paleozoic rocks comprising Potsdam sandstone, Theresa passage beds, Little Falls dolomite, Black River (Lowville) limestone, Trenton limestone, and Canajoharie (Trenton) black shale. Altogether the thickness of these strata is about five hundred feet and their areal extent about three square miles. The valley is of the nature of a fault basin with distinct faults along the eastern and western sides and a minor one between. Along the western side of the outlier the displacement of the fault is no less than 2000 feet, the Canajoharie shales showing a decided updrag effect near the fault. A very careful survey of the vicinity of Wells has been made resulting in the first detailed areal map (with structure sections) of this the most interesting Paleozoic rock outlier in the Adirondacks.

Another feature of special interest is the discovery of an outlier of Paleozoic rock in the Sacandaga valley from one to two miles above Hope post office. The only strata visible are considerable ledges of Little Falls dolomite and a little of the Theresa passage beds and Black River limestone. These strata are sharply downfaulted at least 1200 feet against the steep mountain on the western side of the valley. A minor fault appears to bound this outlier on the east so that this too seems to be a fault basin.

The major topographic features of the quadrangle are largely determined by normal faults, most of which strike northeast-southwest, though certain important cross faults also occur. There are many good examples of fault blocks, ridges and basins.

Glacial striae show the movement of the great ice sheet to have been southward to southwestward. There are several fine examples of extinct glacial lakes, especially those in the valley at Wells; along the Sacandaga river between the mouth of the

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West Branch and Northville; and in the valley of the West Branch in the vicinity of Whitehouse.

During the year we have issued a bulletin on the *Mineral Springs of Saratoga,* prepared by James F. Kemp, in connection with the series of investigations of the Saratoga district which have been in progress for several years. The region here concerned is covered by the Saratoga and Schuylerville quadrangles and the rock geology, especially intricate in the latter quadrangle, has now been finally mapped by Doctors Cushing and Ruedemann. Features of special importance in the Schuylerville region are the great overthrusts and overturned folds in the Bald mountain district and the problem presented by the Schuylerville volcanic plug penetrating the Paleozoic slates. The latter has been much debated. The shales about the volcanic mass have been distinctly overthrust and it seems very evident that the eruptive has been involved in this movement. There are reasons for regarding the plug as of Postpaleozoic age and as thrust by lateral shove many miles westward of its original position.

The investigation of the structure of the shale belt of the Schuylerville and Saratoga sheets has led to the inference that the mineral waters of Saratoga fill a wide basin below the shale formed by the Potsdam sandstone and overlying Cambric and Ordovicic limestones and that the water of the Saratoga springs is derived by filtration through mountain folds about the Hudson river and carried westward under the thick cover of the Canajoharie shales to the Saratoga-Mount McGregor fault and its branches, where it finds the thinnest cover of shale and thus escapes. The Canajoharie shale rapidly thickens southward on account of its dip, and the projecting fault blocks of Precambric rocks close the basin to the northward.

Outside of this immediate region, the work in the shale belt has further brought out the fact that the thick formation of the Normanskill shale comprises two divisions, a lower one corresponding to the Chazy, and an upper, corresponding to the Lowville-Black river interval. Normanskill shale graptolites were found in shale intercalated in the grit beds extending many miles along the Hudson about Hyde Park, N. Y., indicating that the shale belt there may be largely of Normanskill age. The broad belt of rocks extending from Schodack Landing to Stockport has hitherto been entered as Georgian on the State map, but the larger middle part of this is now known to consist of Deepkill

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shales, such characteristic graptolites as Didymograptus nitidus and Goniograptus thureaui having been found in railroad cuts below Stuyvesant.

In southeastern New York the complex problems involved in the *Tarrytown* quadrangle have received attention from Dr Charles P. Berkey who has been aided in his interpretations by his extensive knowledge of the underground rock structure in the course of the Catskill aqueduct.

The *Clove* quadrangle involving an area of Precambric and highly altered Paleozoic rocks east of Poughkeepsie has been studied by Prof. C. E. Gordon and for the most part mapped. The gneisses of the Highlands extend northward as a huge spur in the southeastern part of the quadrangle, and on the west and northwest are overlain by and faulted with the lower Cambric quartzite which in turn is faulted with the Fishkill limestone. Both quartzite and limestone continue northeastward from the Poughkeepsie quadrangle and all three associated formations present essentially the same relations in both areas.

At Poughquag, in the town of Beekman, is the type locality of the basal quartzite of southeastern New York and while fossils have not yet been found in it, the structural relations clearly demonstrate its identity with the rock yielding Olenellus at Johnsville in the town of East Fishkill. The basal quartzite ends against the schist of West Pawling mountain about two miles northeast of Poughquag. Between Poughquag and this point, what appears to be the northern margin of the quartzite forms "Garden Hollow." The drift is very heavy along the northern margin of the Highland spur, forming an exceptionally fine drumlin topography near Stormville, Green Haven and Poughquag. Northeast of the last village, it greatly obscures the relationships of quartzite, limestone and schist.

The northern boundary of the Fishkill limestone followed east from the Poughkeepsie area for a short distance presents the same serrated character, a short toothlike spur appearing just north of Sylvan lake. It then continues as a long narrow tonguelike spur eight or ten miles north of Poughquag in the valley of Fishkill creek and forms what is known as the "Clove." In tracing the eastern boundary of the limestone with the schist, a fine example of coarse fault brecciation was noted a mile and a half north of the hamlet of Clove indicating the character of the contact.

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On the east the gneissic spur is overlain by schist which west of Pawling forms what is known as "West Pawling mountain" and farther north between the "Clove" and the Dover valley forms "Chestnut ridge." This garnetiferous mica schist, at places showing well-developed crystals of cyanite, is regarded as the metamorphosed derivative of the "Hudson river" slates. West of the "Clove" it grades into grits, phyllites and slates.

At Whaley pond is a patch of limestone known as the "white ledge" which is quite isolated from any other limestone outcrops. It is overlain by a quartzite, very similar to the basal quartzite and while clearly lying against the gneiss at places, apparently grades upward into the schist and appears to be a member of that formation. The relations of gneiss and schist along the eastern margin of the spur are still obscure.

Extending from the southern to the northern boundary of the quadrangle through the townships of Patterson, Pawling and Dover is the Dover-Pawling limestone valley. This has been mapped as far north as Wingdale. The eastern and western margins of the valley are irregular and in many places show a confusion of schist and limestone patches of varying sizes in juxtaposition and in such further relation as to suggest that they are dismembered portions caused by disturbances from beneath. Two miles north of Pawling at "Corbin hill" is a large patch of gneiss which is believed to be an inlier of the Precambric rocks; a broken piece of the Precambric floor thrust up among the younger rocks. It is bounded on the east, south and west by limestone and on the north by schist, and the field relations, as thus far studied, favor the view that all the contracts are faulted. The northwestern slope of the hill is heavily drift-covered.

East of the Dover-Pawling valley, as far north as Wingdale, the schist rises as a high mass of passes eastward into Connecticut.

SURFICIAL GEOLOGY

In continuation of his previous observations, work was carried on by Prof. H. L. Fairchild in the Hudson-Champlain valley.

In the report for 1911 (Museum Bulletin 158, pages 32–35), the hypothetical glacial Lake Vermont of Woodworth (Museum Bulletin 84) was provisionally accepted, and some high level shore features about Covey hill and in the St Lawrence valley were correlated with it. Some yet higher beach phenomena

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were attributed to glacial waters held up to the level of the Altona spillways, and these waters were called Lake Emmons.

Further study of the problem led to serious doubt of the correctness of these views concerning the ancient waters of the Champlain valley, and specially of the nature of the so-called Vermont waters, and it became necessary to reexamine the phenomena.

Under the theory holding the Vermont waters as glacial the summit plane of the marine waters was thought to be represented by the top of the series of heavy cobble bars about Covey hill, with an altitude of 525 feet. The shore features above this level were attributed to glacial lake waters. This view was accepted by Professor Goldthwait, who was studying the marine plane in the lower St Lawrence valley for the Canadian Survey.

Several considerations, specially the amount of land uplift in the district indicated by the Iroquois outlets, induced the belief that the Covey hill cobble ridges did not represent the highest stand of the oceanic waters, and that the " Lake Vermont " features (about 650 feet at Covey hill) were also produced by sea-level waters. At the beginning of the summer's work in 1912 a field conference was held with Professor Goldthwait and the features on a part of the Mooers quadrangle were reviewed. The beach phenomena between the Covey hill bars and the Vermont plane are very weak in that district. The lack of definite shore features above the summit plane of the Covey hill bars, 525 feet, is in strong contrast with the heavy development below that plane. The results of the conference were unfavorable to the view that the land surface above the Covey hill plane had been slowly raised out of the sea-level waters, like the slopes below that plane.

Immediately following the conference an examination was made of the phenomena on the territory south of the Mooers quadrangle, the newly surveyed Dannemora quadrangle, taking advantage of an advance copy of the unpublished Dannemora sheet. A very unexpected and surprising display of shore features was discovered. It was found that south of the Mooers quadrangle the Covey hill shore features are almost wanting, being replaced in the vertical position by a deluge of sand. But ranging above the Covey hill plane is a remarkable development of beach and delta features, reaching up to 700 feet. The strongest display of the cobble bars represents the " Vermont " plane, here

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from 500 to 600 feet, and they extend practically throughout the whole length of the Dannemora quadrangle. It is evident that these beaches correlate with the Cobblestone hill bars and other detached features on the Mooers quadrangle that formerly were puzzling.

Being specially developed in the town of Peru these bars in the "Vermont" plane will be called in this report the Peru beaches. This shore exhibits all the characters which argue for the marine origin of the Covey hill beaches. Taken in connection with the features on the adjacent Mooers quadrangle they afford an excellent illustration of the lack of value of negative evidence in study of shore lines, and the error in judging confidently from a single district or a limited area.

The Peru ("Vermont") shore phenomena are found to be well developed southward throughout the Champlain valley, on both sides of the valley, and to lie far above the Fort Edward divide. They have been mapped on the Vermont side at Burlington, Middlebury and Brandon. The plane declines from 700 feet on the international boundary to 660 feet at Cobblestone hill, 520 feet near Ticonderoga, 440 feet near Glens Falls, and 390 feet near Mechanicville. The slope of the plane is a little over two feet a mile. These beaches are not the highest or summit bars of the region but were formed after some uplifting of the land had taken place. Their strength suggests that they represent a relative pause or a slower rate in the land uplifting.

The highest well-developed bars found on the Dannemora quadrangle are 706 feet in height, and lie west of Peru village. Behind the highest shore features throughout the quadrangle lie glacial drainage channels, terminating in deltas. These channels and deltas definitely determine the height of the standing waters during the recession of the ice front. This altitude on the Dannemora quadrangle was over 700 feet.

Northward the summit plane of the Champlain waters during the time when the ice sheet was waning is represented by beaches at Shea's Lines, on the Canadian boundary, south of Covey Hill post office, at about 750 feet; and also by the series of good bars at Cannon Corners, with an altitude of 750 feet. Southward the summit of the standing water is shown in various localities and specially at Port Henry. In the Hudson valley it is well shown. It is found that many cities and villages on both sides of the valley are located on broad summit plains of deltas

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that were built in the marine waters that occupied the valley as the ice gave way. This water plane rises from zero in the vicinity of New York to at least 350 feet at Schenectady, or at the rate of 2.2 feet a mile.

The practical continuity and correspondence in level of the highest water plane on both sides of the Hudson-Champlain valley proves that the waters filled the entire breadth of the valley and that the shore phenomena are not the product of ice-border lakes. It also appears that the waters were not held up by any moraine dam or any barrier of land uplift.

Over the Fort Edward divide the waters were more than 300 feet deep, and all the phenomena in the Fort Edward-Schuylerville district are those of static waters, slowly lowering and terracing the copious detrital deposits on both sides of the valley. There is found no evidence of any glacial stream flow below the summit water plane.

As the ice front melted back the ocean followed it and flooded the valley. The waters were at first the Hudson inlet; later the Hudson-Champlain inlet; and finally the Hudson-Champlain strait.

The minimum amount of continental uplift on the Canadian boundary is approximately determined by the deformation of the Iroquois plane. In the former report (page 32) it was shown that if we assume the Covey gulf outlet of Lake Iroquois to have been no lower than the original Rome outlet, then the district must have been lifted at least 665 feet. This makes the Covey hill bars 140 feet below the marine summit. The total uplift must have been as much more than 665 feet as the gulf outlet was beneath the plane of the Rome outlet. The study of the high-level shore phenomena leads to the confident belief that the Covey hill district has been uplifted at least 750 feet since the ocean waters displaced the ice sheet. This would carry the gulf channel only 85 feet beneath the Rome outlet.

Summary. Heavy and conspicuous static water phenomena occur with practical continuity on both sides of the Hudson-Champlain valley from New York City to Canada, rising steadily from zero at New York to 750 feet at the north edge of the State. Above this plane the land is cut by glacial drainage. All the facts now known and the relationship of the beaches to the topography of the valley walls indicate that the waters were confluent with the ocean. The absence of marine fossils in the

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higher deposits is probably chiefly due to the freshening of the water in the narrow inlet and strait by the very copious glacial waters.

INDUSTRIAL GEOLOGY

General review. The work in industrial geology which is directed chiefly to the investigation and description of the State's mineral resources has been carried forward actively during the past year. The annual summary of the local mining field, prepared in the form of a report for the general guidance of those engaged in the industry or otherwise interested in its current progress, has been continued, and the latest issue brings the information down to the close of 1911. Besides complete production statistics, the report contains notes and short articles dealing with the present sources of supply of the valuable minerals and the more interesting features involved in their exploitations. In the year 1911, conditions on the whole were rather unfavorable to mining and quarry operations; very few branches were able to report progress in terms of increased output. The aggregate valuation of $31,573,111 for the crude products was less by about 10 per cent than the total returned in the preceding year. The iron mining industry showed the full effects of the depression, as it is always very responsive to economic changes. The clay-working and quarry industries, especially the departments engaged in the production of building materials, were likewise much depressed. The setback had no serious consequences so far as concerns the permanent welfare of the industries, and it is expected that the record for 1912 will show some improvement, if not material gains, in many branches.

Talc. A sketch of the talc deposits of St Lawrence county and the present status of their industrial development has been prepared to meet the public inquiry for information on the subject. Some interesting developments have taken place during the last year or two, and it is hoped that with the preparation of large-scale topographic maps, a work now in progress, the opportunity will soon be forthcoming for a comprehensive account of the geology and economic features of the district. Since commercial operations were started, a little over thirty years ago, the mines have contributed nearly a million and a half tons, all of which required mechanical preparation before shipment to market. There is no other district in this country where the mining and milling of talc is carried on on so large a scale. The occurrence of metallic ores, including zinc blende, pyrite and hematite, in close proximity with

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the talc and in the same geological surroundings, is a noteworthy feature which has only recently attracted attention. The ores form pockets and bands in limestones and schist with the characteristics of replacement deposits. In any case, they have undoubtedly been introduced in solution and precipitated in their present place after the upraising of the sediments represented by the wall rocks. It would appear probable from these and from other considerations which need not be entered upon here that there is a close genetic relation between the talc and the metallic minerals. This point is of some significance in regard to the probable extent of the talc deposits and renders a more detailed investigation of the field highly desirable.

Zinc. A brief visit to the zinc ore localities of St Lawrence county was made during the summer for the purpose of studying the occurrences and securing material for the collections. There has been much activity in prospecting within the district, but the recent developments have been restricted, as in the previous year, to the locality near Edwards. As the result of recent discoveries, it is known that zinc blende has a rather wide distribution in the section from Edwards to Sylvia lake, which is practically coextensive with the talc district. The economic importance of the deposits is scarcely to be estimated as yet, but the work on the single property that is under exploration, lends encouragement to the hope that a substantial industry may be developed. Some difficulty has been encountered in the mill treatment of the ore which contains more or less pyrite in intimate association with the blende, the two minerals occurring usually in finely divided intergrown particles.

Field observations show that the blende is found in crystalline limestones of the same belt that includes the talc and tremolite beds. The limestone belt is interrupted here and there by bands of rusty, quartzose schists, and by dark basic hornblende and biotite gneisses. The rusty schists are very certainly a part of the same sedimentary series representing probably old sandstones, while the hornblende and biotite gneisses also are believed to be derived from sediments of the nature of shales, though in places they may represent altered igneous intrusions of gabbroic nature. The gneisses and schists have been invaded by a red granitic rock, with pegmatitic phases, that is developed in dikes, bands and occasionally as bosses of some size. The granite is perhaps related to the great batholiths of that rock which are found in the interior of the Adirondacks. The gneisses have been so injected and soaked by the granite that in places they partake quite as much of igneous as of gneissic

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character, in fact, all gradations from the one rock to the other may be found.

The limestones and schists have a northeasterly strike and are upturned at a high angle. The limestones of this section carry abundant impurities, though elsewhere the same series may be nearly free from admixture. The principal foreign minerals are silicates, most commonly tremolite, serpentine and talc. They are either scattered in small aggregates, or they form nodules, bands and veinlike bodies of practically solid silicates. The limestones are magnesian and in the vicinity of the ore bodies show the effects of solution and decomposition by ground waters. The circulation of water has been facilitated apparently by the broken, shattered nature of the rock which has undergone severe compression and more or less differential movement. The process of dolomitization and silication has preceded for the most part the introduction of the ores, but it may have resulted from the same agency, that is by the transporting of silica and magnesia held in solution in meteoric or deep-seated waters.

The zinc blende occurs in lenses and bands and also as scattered particles within the limestone. The deposits have the appearance of replacement bodies rather than the fillings of open fissures or cavities. In most places, the borders of the richer bands are not sharply defined, but are in the nature of transition zones which shade off gradually into the limestone. The internal structures are not those characteristic of open-fissure fillings as there is no appearance of crustification or of drusy cavities lined with crystallized minerals. The compact granular nature of the ore furthermore suggests deposition at considerable depth and under pressure.

The recent development work at Edwards has disclosed some interesting features in regard to the deposition of the ores which are the subject of current study. The problem as to the derivation of the ores seems to be interrelated with the partial silication of the limestones which has led to the formation, in the first place, of tremolite. This mineral has changed over to talc, more or less completely, through normal weathering or, which appears more likely, as the result of decomposition brought about by the later stages of the underground circulations that deposited the ores. The serpentine in larger part, however, seems to have formed directly, that is deposited as such from solution and not originating as an alteration product of an anhydrous mineral. Some of the serpentine is certainly later than the metallic minerals, as shown by the veins and stripes of the colloidal variety which intersect the ore,

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There are rounded aggregates which may represent an earlier generation, perhaps derived from a silicate mineral of the pyroxene or hornblende family. The talc nodules are frequently bordered by veins of massive serpentine that appear to have resulted as a reaction from contact of the talc with iron-bearing solutions. The limestones at this place have undergone considerable disturbances from regional compression since the deposition of the ores, manifested by the brecciated and faulted condition of the deposits in certain places and the flowage of the limestones into the fractures so as to cement the broken and disjointed parts. The whole mineral association seems referable to the work of underground waters which in a period of long-continued circulation have introduced and deposited various ingredients. There is insufficient evidence, as yet, to connect the mineralization with igneous agencies, and if these have been a factor, they were no doubt connected with the granite invasion, the only intrusive that has any prominence in the district.

SEISMOLOGIC STATION

The year's records for the local seismologic station are given in the accompanying table in conformity with the plan previously used in reporting the data. The list, it may be noted, includes only such disturbances as set up prolonged and well-marked vibrational movements, usually differentiated into phases — such as are referable without much doubt to true tectonic shocks transmitted to the station from more or less remote origins. Of almost daily occurrence are brief or indistinct motions arising from various causes not wholly explained, but these have not been taken into account in the table.

The number of individual tracings of earthquakes obtained within the year ending September 30, 1912 was twelve, as compared with nine in the preceding period, and nineteen in the year 1909–10. This record seems to indicate a general falling off of late in seismic frequency, at least with respect to the heavier shocks which are recorded mainly at the Albany station. There have been at the same time few destructive disturbances; within the past year, none has transmitted vibrations that exceeded the capacity of the instrument for registration.

Since the station was established in March 1906, it has supplied data in regard to ninety-eight individual shocks. In view of the fact that the installation represents an early type, comparatively, the results may be considered quite satisfactory. They sufficiently demonstrate that the somewhat peculiar conditions existing in this

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vicinity, particularly with respect to the heavy mantle of glacial sands and clays which cover the bedrock, are not incompatible with such service. The instruments belong to the lighter pattern of the horizontal pendulums and are not capable of a magnifying ratio of more than ten to one in the average run. They possess, however, the requisite sensitiveness for recording legibly the tremors of all heavy or damaging quakes throughout the seismic zones of this and other countries. There are in the local files tracings from such widely separated origins as California, Valparaiso, Kingston, the Himalayan region, Turkestan, Messina, Mexico, Costa Rica, Iceland, northern Alaska and Turkey in Europe. The smaller distant quakes, as well as the very slight jars from nearby sources, appear to be beyond the capacity of the instruments to register.

The general care of the instruments during the year has been assumed by Mr R. W. Jones. With their increasing age, they have required more attention to maintain them in working order, especially on account of their liability to rust. The station is very damp during the summer months and then they have to be frequently dismantled and thoroughly cleaned. As yet, no provision has been made for their removal to new quarters, and their maintenance in their present place will entail added labor for the future. In case a new station should be equipped near the present location of the Museum, it would appear advisable to instal one of the newer types of seismographs for registration of the smaller quakes, along with the present instruments which are well adapted to the registration of macroseisms.

RECORD OF EARTHQUAKES AT ALBANY STATION, OCTOBER 1, 1911 TO SEPTEMBER 30, 1912

Standard time

DATE	Beginning preliminaries	Beginning principal part	Maximum	End	Maximum amplitude
1911	H M	H M	H M	H M	mm
December 16.....	2 20½ P. M.	2 36 P. M.	2 38 P. M.	3 30 P. M.	15
1912					
January 31.....	3 20 P. M.	3 35½ P. M.	3 36 P. M.	4 25 P. M.	10
March 11.....	.....	5 38½ A. M.	5 39 A. M.	6 00 A. M.	3
May 6.....	2 06½ P. M.	2 19 P. M.	2 20½ P. M.	3 20 P. M.	7
May 22.....	9 50½ P. M.	10 18 P. M.	10 22 P. M.	11 00 P. M.	4
June 7.....	5 56½ A. M.	.....	.....	6 17 A. M.	½
June 7.....	7 41 A. M.	.....	.....	8 35 A. M.	½
June 7.....	1 40 P. M.	.....	.....	2 30 P. M.	1
June 8.....	2 46 A. M.	3 01½ A. M.	3 05½ A. M.	3 40 A. M.	10
June 10.....	11 15½ A. M.	11 33½ A. M.	11 38½ A. M.	12 30 P. M.	8
June 12.....	7 49½ A. M.	.....	7 59 A. M.	8 30 A. M.	½
July 8.....	4 57½ P. M.	5 17½ P. M.	5 18½ P. M.	6 00 P. M.	8

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December 16th. A clearly marked record of the earthquakes that shook the city of Mexico on this date. The phases are well differentiated and give a very close approximation of the distance to the source, about 3000 miles. The larger vibrations are exhibited on the north-south component. Although the record would indicate it to be one of the heaviest shocks of the year, it appears to have done little damage.

January 31st. A good tracing of the earthquake that was central near Valdez, Alaska, when it occurred at about 10.12 o'clock in the morning. The east-west component is the larger. The indicated distance to the source is about 3000 miles.

March 11th. The preliminary tremors are not shown on the record. The origin appears to have been relatively near, perhaps in the West Indies. The Harvard station estimated the distance at about 1000 miles.

May 6th. A second Mexican quake, felt in the city of Guadalajara. The record is fairly clear, but less strong than that of December 16th. The tremors traveled as far as Germany.

May 22d. The record of a long-distance microseism with a period of from 20 to 30 seconds. It is not clearly separated into phases. An earthquake was reported from the Hawaiian islands on this date.

June 7th. A series of probably related disturbances from a source between 3000 and 4000 miles away, but not definitely located. A volcanic outburst occurred in the Alaskan peninsula about this time.

June 8th. This probably marks the culmination of the series of shocks which began the preceding day. Besides the heavy disturbance, there were light tremors at intervals which were so broken up by interference as to permit no satisfactory readings. The more notable of these minor movements occurred between 4.10 and 4.30 a. m., 5.22 and 5.33 a. m., and 7.55 and 8.45 a. m.

June 10th. An untraced disturbance about 3500 miles away.

June 12th. Very faint record, apparently not connected with the tremors, felt in South Carolina and Georgia the same morning.

July 8th. A rather strong disturbance with the east-west wave motion more pronounced than the north-south. The estimated distance of the source is about 4000 miles. A heavy shock occurred at Fairbanks, Alaska, about this time.

PALEONTOLOGY

In the reports of several years past, reference has been made to the progress of a memoir on the fossil arachnids or Eurypterida

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of New York. The work has now been completed and issued. It is the summation of many years of labor in the acquisition and study of this interesting extinct group of animals, which, by virtue of their abundance and variety in the rocks of New York, form one of the very striking features of its paleontology. This memoir is presented in two volumes, one of text and one of plates, the pages numbering 628 and the plates 88. A conception of the contents of the memoir is conveyed by its table of contents:

Volume 1

	PAGE
Preface	5
Introduction:	
History of investigations	13
Eurypterida I Morphology, anatomy, and terminology	23
II Mode of life	71
III Geological distribution and bionomic relations	85
A Conspectus of American species arranged according to their geological occurrence	85
B Biologic facies of the eurypterid faunas	90
Eurypterida III C Geological distribution in other countries	94
D Bionomy of the eurypterid faunas	96
IV Ontogeny	113
V Phylogeny	124
VI Taxonomic relations	135
VII Synoptic table of North American Eurypterida	149
VIII Systemic account of the Eurypterida	152
Eurypteridae	152
Pterygotidae	329
Appendix	385
Bibliography	432

Volume 2

	PAGE
Explanations of plates	441
Index	617

In last year's report a brief notice was given of an extraordinary section of the Siluric rocks on the Bay of Chaleur, at Black Cape. Previous to this account, only very brief notice had been taken of this place in the geological reconnaissance of that region, but as this section proves to be one of the extraordinary developments of the Siluric system, attaining a thickness of deposition perhaps not elsewhere equaled, it seemed very desirable to have a more exact examination of it made. With the consent and substantial support of the director of the Geological Survey of Canada, C. A. Hartnagel of this staff was detailed to this work.

Black Cape lies on the north shore of the Bay of Chaleur, seventy miles east of Matapedia and directly east of the valleys of the Grand

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and Little Cascapedia rivers. In the Siluric section the strata are nearly all calcareous with intercalations of red shale near the top. They stand at high angles to the horizon, usually dipping 60–80° s. e., but these dips vary somewhat, though without unconformities. The eroded edges of the strata are overlain elsewhere in the region by the red sands and conglomerates of the Bonaventure formation, and there are several considerable fissures in the Siluric limestones which are filled in with red sand derived from the overlying beds. All these occurrences indicate land exposure of the Siluric during all the early and middle Devonic time.

The base of the section at the west begins with greenish, highly nodular lime-shales, very compact and heavy bedded, weathering out into irregular and gnarled shapes. These alternate with more highly calcareous shales and compact limestones of red and ochreous tints. These compact limestones contain Stricklandinias of great size (S. gaspensis Billings) and in great number and with these are Spirifers of the S. radiatus-niagarensis type and occasional Whitfieldellas. Throughout the lower beds the rest of the fauna is largely of Stromatoporoids and corals which occur in enormous quantity and great diversity. There are Halysites of several species, having horizon values, Favosites and Alveolites of great size, Heliolites, Syringopora, Eridophyllum in extensive colonies, Zaphrentis and other cyathophylloids in considerable variety. Additional species in these lower beds are Calymmene, Chonetes, Atrypa reticularis (Siluric type), Tentaculites, cyclostomatous gastropods, etc.

At an elevation in the series of about 1500 feet, where the scraggy limestones continue, there is some indication of change in the fauna by the addition of brachiopods of the genus Camarotoechia, Rafinesquina, the cephalopods Orthoceras, Trochoceras, etc. From Howatson's (elevation on section, 1500 feet) on eastward the scraggy limestones continue as far as the breakwater. Then follows a heavy mass of sandy shale. This sedimentation continues sandy to near the end of the section which terminates at the volcanic mass forming Black cape, but toward the top the sands become interlaminated with thin beds of volcanic ash, with red and purplish shale and eventually calcareous and variegated beds succeed to these, becoming in places compact lime banks entirely constituted of the debris of fossils.

These sandstones and sandy shales are remarkably profuse in

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corals, some of the species being palpably unlike those of the lower beds. Beyond the volcanic mass known as Black cape, there are several noteworthy inclusions of the fossil-bearing limestones within the lava.

So far as at present indicated by the fossils, this section from base to top is of the age of the Niagara (exclusive of Clinton) or Rochester shale of the interior Siluric, though the assemblage will doubtless show a preponderance of Atlantic or European types which will bring it into more proper comparison with the Gulf sections at Arisaig and on Anticosti island. Its thickness is not less than 7000 feet and in this respect the section overpasses any Siluric section known in America.

V

REPORT OF THE STATE BOTANIST

The plants collected during the season of 1911 have been mounted on herbarium sheets and arranged in their proper places in the herbarium or placed in boxes and distributed as far as possible in their proper places. Lack of room has prevented the completion of this work, but it is expected that removal to the Education Building will soon obviate this difficulty.

Specimens of plants, indigenous and naturalized, for representation of the species in the State herbarium have been collected in the counties of Albany, Essex, Lewis, Livingston, Monroe, Steuben and Sullivan.

Specimens have been contributed that were collected in the counties of Albany, Chautauqua, Cattaraugus, Clinton, Columbia, Fulton, Hamilton, Herkimer, Monroe, New York, Oneida, Ontario, Onondaga, Orleans, Oswego, Rensselaer, Richmond, Schoharie, Suffolk, Tompkins, Ulster, Warren and Washington.

Specimens of extralimital species have been contributed that were collected in Canada, California, Connecticut, Cuba, District of Columbia, Indiana, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Montana, New Hampshire, New Jersey, North Carolina, Ohio, Pennsylvania, Utah and Vermont.

The number of species of which specimens have been added to the herbarium is 278 of which 72 were not before represented therein. Of these, 11 are considered new or hitherto undescribed species.

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The number of those who have contributed specimens of plants is 70. This list includes the names of those who sent specimens for identification only, if the specimens were of such character and condition as to make them desirable additions to the herbarium. The number of identifications made is 1859; the number of those for whom they were made, 136.

Two species of mushrooms have been tried for their edible qualities, and though neither can be considered first class in all respects, both have been found to be harmless and palatable and have been approved as edible. Colored figures of them have been prepared and descriptions have been written. These make the whole number of New York species and varieties of mushrooms now known to be edible 215.

A small but attractive looking mushroom was discovered growing among decaying pine leaves in Richmond county by W. H. Ballou. He found it to be very poisonous. It is therefore figured and described as a poisonous fungus.

Specimens of seven species of Crataegus or thorn bushes have been added to the herbarium. Of this genus of trees and shrubs, 218 New York species are now recognized. Prof. C. S. Sargent, the eminent crataegologist, has kindly prepared a synoptical key to our New York species. This was a most difficult and intricate piece of work which none but an expert in this peculiar branch of botany could well do. In this work he has laid an excellent foundation for the study of these interesting though often considered nearly worthless and annoying shrubs and trees. He has added to this descriptions of 25 new species of this genus.

PLANTS ADDED TO THE HERBARIUM

New to the herbarium

Achillea ptarmica *L.*
Amanita ovoidea *Bull.*
Anellaria separata (*L.*) *Karst.*
Aposphaeria fibriseda (*C. & E.*)
Artemisia carruthii *Wood*
A. dracunculoides Pursh
A. glauca *Poll.*
Arthonia quintaria *Nyl.*
A. radiata (*Pers.*) *Th. Fr.*
Betula alba *L.*
Bolbitius vitellinus (*Pers.*) *Fr.*
Boletus retipes *B. & C.*
Calosphaeria myricae (*C. & E.*) *E. & E.*
Calvatia rubroflava (*Cragin*) *Morg.*
Chrysothamnus pinifolius *Greene*
Clavaria grandis *Pk.*
C. vermicularis *Scop.*
Cladochytrium alismatis *Büsgen*
Collema crispum *Borr.*
Collybia murina *Batsch*
Coronopus procumbens *Gilibert*
Crataegus gracilis *S.*
C. harryi *S.*

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Crataegus leptopoda *S.*
C. livingstoniana *S.*
C. macera *S.*
C. procera *S.*
Creonectria ochroleuca (*Schw.*) *Seav.*
Diaporthe castaneti *Nits.*
Diatrypella favacea (*Fr.*) *Ces. & DeNot.*
Didymella asterinoides (*E. & E.*) *Rehm*
Dothidea baccharidis *Cke.*
Escholtzia californica *Cham.*
Flammula graveolens *Pk.*
Helicopsis punctata *Pk.*
Heliomyces pruinosipes *Pk.*
Helminthosporium fuscum *Fckl.*
Hydnum laevigatum *Sw.*
H. subcrinale *Pk.*
Hygrophorus ruber *Pk.*
Inocybe radiata *Pk.*
Lenzites trabea (*Pers.*) *Fr.*
Leptonia euchlora (*Lasch.*) *Fr.*
Macrophoma juniperina *Pk.*
Malus glaucescens *S.*
Mycena flavifolia *Pk.*
M. splendidipes *Pk.*
Opegrapha herpetica *Ach.*
Penicillium hypomycetes *Sacc.*
Pestalozzia truncata *Lev.*
Phialea anomala *Pk.*
Phoma asclepiadea *E. & E.*
P. semiimmersa *Sacc.*
Phyllosticta mahoniaecola *Pass.*
P. rhoicola *E. & E.*
Placodium camptidium *Tuck.*
Pleurotus tessulatus (*Bull.*) *Fr.*
Polyporus dryadeus (*Pers.*) *Fr.*
Puccinia urticae (*Schum.*) *Lagerh.*
Riccardia sinuata (*Dicks.*) *Limpr.*
Russula ballouii *Pk.*
Septoria margaritaceae *Pk.*
Silene dichotoma *Ehrh.*
Tricholoma latum *Pk.*
T. piperatum *Pk.*
T. subpulverulentum (*Pers.*)
Urophlyctis major *Schroet.*
Vermicularia hysteriiformis *Pk.*
Verrucaria muralis *Ach.*
V. papularis *Fr.*
Vicia hirsuta (L.) *S. F. Gray.*
Zygodesmus avellanus *Sacc.*

VI

REPORT OF THE STATE ENTOMOLOGIST

The State Entomologist reports that the past season was noteworthy because of the superabundance of the common *apple tent caterpillar* in the Hudson and Mohawk valleys and on the borders of the Adirondacks. The pests were so numerous that most of the wild cherries on the roadside were defoliated and many orchards severely injured. There were records of local damage here and there by the allied *forest tent caterpillar;* in several sections extended tracts were stripped of foliage. There is at least a fair probability of this insect being more abundant another season and possibly causing serious injury locally. The *green maple worm,* so numerous last year, attracted no attention the past season.

Petroleum compounds as insecticides. Dead and dying trees in several Greene county orchards which had been sprayed the preceding autumn with a commercial preparation of petroleum,

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led the Entomologist to study carefully the cases and the behavior of the trees through the season. A comparison was also made between the condition of these trees and injury of earlier years following applications of petroleum. He was unable to note any material difference between the two and, furthermore, observed a marked restriction of the damage to trees or even portions of trees which had received the application. After a careful study of the various phases of the matter he was forced to conclude that a certain measure of risk attaches to the application of mineral oils or preparations of the same to trees in a dormant condition. This matter is discussed in detail in the Entomologist's report.

Fruit tree pests. The experiments conducted by the Entomologist during the last three years against the *codling moth* were continued in the orchard of Mr Thomas Albright, of New Baltimore, and very satisfactory returns obtained. The check or unsprayed tree produced only 38.95 per cent of sound fruit, while sprayed trees of the same variety, less than 100 feet away, yielded over 97 and in some instances more than 98 per cent of worm-free apples. The results of this experiment and those of earlier years were checked by a careful study of representative trees in the orchards of Messrs W. H. Hart, of Poughkeepsie, and Edward Van Alstyne, of Kinderhook. These latter were sprayed under strictly commercial conditions with no expectation at that time of their being subjected to a test later. The results in these commercial orchards were very gratifying. The northern spies belonging to Mr Hart produced an average of over 98 per cent of sound fruit, while the greenings and Baldwins on the Van Alstyne place gave an average of over 96 per cent of worm-free apples. The past four years' experiments go far to show that under normal crop conditions one thorough and timely spraying for the codling moth should result in producing from 95 to 98 per cent of sound fruit. These tests are of great practical value to the fruit grower, since they afford a reliable basis for correctly estimating the value of spray applications.

The *pear thrips*, a minute insect which blasted or nearly destroyed the pear crop in a few orchards in the Hudson valley, was studied with special reference to conditions favoring injury, and the efficacy of spraying with a tobacco preparation demonstrated. The insect, potentially a very dangerous form, is discussed

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in the Entomologist's report. The work of the *pear midge* was investigated and a number of desirable photographs of the larva and its work secured.

Gipsy moth. The danger of injury by this notorious pest was emphasized by the discovery of a small colony, practically restricted to a city block, at Geneva. An examination of the locality showed that the infestation was probably of three or four years' standing. The chances are at least fair that the insect was introduced in that section with nursery stock, though no undoubted evidence as to the source of the infestation has been adduced. The discovery of similar colonies may be expected from time to time. For a period at least, no effort should be spared to exterminate such outlying infestations, since this policy is much cheaper and decidedly more advantageous to the general welfare than the adoption of repressive measures with the inevitable slow spread of the insect and the greatly increased cost of controlling the pest incident to its being distributed over an extended area. Such measures are also advisable, since checking the normal spread is most advantageous for the development of introduced parasites, a number of which have already been established in this country.

The recent enactment by Congress of a national plant quarantine act, recommended by the Entomologist and his associates in other states, is an important step in advance and should prove of great service in restricting the spread of this and other injurious insects as well as preventing the introduction of dangerous pests.

Brown-tail moth. This species has attracted comparatively little attention the past season, though owing to its having become established in the northwestern corner of Massachusetts, it is only a question of time before it will make its way into this State. The danger of this pest being introduced on nursery stock grown in infested sections still exists and should not be overlooked simply because a portion of the State is contiguous to infested territory. The winter nests are so characteristic that there should be little difficulty in identifying the insect and at the outset prevent its becoming excessively abundant.

Grass and grain pests. *White grubs* have been extremely numerous in portions of Albany, Columbia and Rensselaer counties, at least. They were so abundant in many places as practically to

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kill the grass over areas half an acre or more in extent. The roots were almost entirely destroyed and in many fields much of the sod was, as a consequence, torn loose where a horse rake was used. The outbreak was taken advantage of by the Entomologist to study in representative spots, the work of the grubs, their habits and natural enemies, with special reference to methods of control. A detailed account of his investigations is given elsewhere.

The *Hessian fly* caused serious losses in the wheat-growing section of western New York, destroying entire fields and, in many cases, reducing the yield by 50 per cent. An investigation of the injury was made for the purpose of ascertaining any peculiarities in its inception and determining the probabilities of serious damage another year. A number of parasites were reared from infested wheat stems collected in representative areas. An extended discussion of this insect is given in the Entomologist's report.

The *fall army worm*, another grass and grain pest, was excessively abundant in the vicinity of New York City, seriously injuring lawns, destroying millet and corn and feeding upon a variety of grasses. This outbreak was also investigated and a detailed account of the insect has been prepared.

Shade tree pests. The widespread and severe injuries of earlier years by the *elm leaf beetle* in the Hudson valley in particular, amply justified extended observations the past season. It was found that the exceptional damage in 1911 resulted in a feeble growth and weakened trees the past season. The early portion of the spring was unusually cool and moist and largely, as a result of these conditions, it is believed that injury by this pest was not so severe as last year. There was a marked irregularity in the work of the beetle, some trees in a locality and in certain cases some localities being almost exempt from injury, while in others the damage was relatively severe. A portion of this may be explained, possibly by more thorough spraying. Experiments were conducted with sweetened and unmodified arsenate of lead for the purpose of ascertaining if any material advantage was to be gained by the addition of a cheap sugar or molasses. There was no marked difference between the two series of tests and the earlier work with poisons was confirmed in large measure.

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The *false maple scale* continues abundant in the vicinity of New York City and was a subject of considerable correspondence during the summer. The *cottony maple scale* was also responsible for a number of complaints.

Forest pests. The *hickory bark beetle* has continued its destructive operations in the vicinity of New York City. The abundance of this pest and the hearty cooperation of Mr J. James de Vyver, of Mount Vernon, made possible a series of tests for the purpose of finding some method which could be relied upon to destroy the insect after the beetles had entered the trees. Studies in the field showed that in some localities many of the grubs died within a few weeks after hatching and before they were able to cause material injury. A detailed discussion of this work, together with the Entomologist's investigations upon the biology of the pest and its natural checks, is given in his annual report.

Many of the white pines in the vicinity of Albany have been killed in recent years by *bark borers*. The Entomologist's study of the conditions showed that in all probability this attack was the outcome of extreme droughts and very low winter temperatures. Parties suffering from the activities of these pests have been advised to cut and burn all infested trees prior to the opening of another season.

Hosts of *Ambrosia beetles* belonging to the genus Platypus attacked freshly sawn, sappy mahogany in the yard of a veneer cutting company near New York City and inflicted severe loss besides causing grave apprehensions. An investigation showed that the insects originated from a shipload of mahogany from Panama. Upon the advice of the Entomologist, the infested material was removed and the few insects remaining soon disappeared.

The destructive work of the *locust leaf miner,* noticed in the Entomologist's report, was studied the past season and additional information secured in relation to its habits and methods of control. The most severe injury, as in 1911, resulted from the feeding of the beetles.

The *woolly bark louse* of the white pines has been the occasion of several complaints during the past summer, and an investigation showed that in some instances at least, large trees were seriously weakened if not destroyed by this insect.

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A previously unknown though sparse colony of the periodical *Cicada* was located at Geneseo as an outcome of the interest aroused by the appearance of the enormous brood last year.

Flies and mosquitos. There has been a general interest in controlling the house fly and preventing the superabundance of mosquitos. Both of these insects have been the subject of correspondence, and a number of bulletins giving directions for remedying undesirable conditions have been distributed.

An unusual departure was the working out of the life history of a common blowfly, Phormia regina Meign. and a flesh fly, Sarcophaga georgina Wied., under controlled conditions. These two insects, though exceedingly common, were comparatively unknown except in a very general way. The details of this investigation, undertaken for the purpose of solving a specific problem, are given in the Entomologist's report.

Gall midges. This large group of small flies has continued to receive attention from the Entomologist. He has succeeded in identifying the wheat midge of Fitch, which proved to be an undescribed species, discovered and described a second form recorded as living in heads of American wheat, and reared another. The last was identified through the cooperation of European entomologists as Thecodiplosis mosellana Gehin. In addition, a number of new gall midges have been reared from various food plants and described. The outbreak by the *Hessian fly*, noted above, and an abundance of the *pear midge* in the vicinity of Albany afforded opportunity for additional studies of two economic forms.

Lectures. The Entomologist, as in past years, has delivered a number of lectures upon insects, mostly economic forms, before various agricultural and horticultural gatherings. This work enables him to become personally acquainted with the problems of various localities and has been greatly facilitated by a chart showing the results secured in the codling moth experiments of recent years.

Publications. A number of brief, popular accounts of the more injurious species of the year were widely circulated through the agricultural and local press. The more extensive publications, aside from the report for last year, are: *The Elm Leaf Beetle and the White Marked Tussock Moth* (Museum Bulletin 156),

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Control of Insect Pests in Institutions, The Identity of the Better Known Midge Galls, The Fundamentals of Spraying and several papers describing new species of gall midges. A list of the Entomologist's more important publications is given in his annual report.

Collections. There have been material additions to the collections through the efforts of the members of the office staff, and also by exchange and donation. Through the courtesy of Dr Otto Nüsslin of Karlsruhe, Germany, the Museum received an excellent series of European bark beetles. Mr Henry Bird, of Rye, generously donated an admirable lot of reared stem borers belonging to *Hydroecia* or closely allied genera, a number of these forms being almost unrepresented outside Mr Bird's exceptionally fine collection. The work of arranging and classifying the Museum collections has continued whenever opportunity offered. Considerable miscellaneous work has been done upon the beetles or Coleoptera, giving special attention to the flea beetles, Halticini of the Chrysomelidae and to the June beetles, Lachnosterna and its immediate allies of the Scarabaeidae. An excellent series of genitalic mounts was made in this latter group.

The value of the collections has been greatly increased by microscopic preparations. Specimens of the Scolytidae received from Doctor Nüsslin and noted above were put in balsam mounts. There were, in addition, two hundred such preparations of gall midges, mostly from reared material, and a number of scale insects, some previously unrepresented in the collections, which were similarly treated. The value of this material is much enhanced when placed in such preparations, since the latter are permanent in character and, in most of the species mounted, necessary for the identification of the insect.

The series of plant groups designed to serve as an embellishing and instructive feature of the enlarged exhibit now in preparation are practically completed. There has been special collecting for this exhibit.

The more ample facilities of the new quarters bring added responsibilities in the opportunity they offer of making the State collection of insects, both for exhibit and reference, thoroughly representative. The magnitude of such a task is appreciated by very few. The Entomologist recently assembled, with the cooperation of recognized authorities in various groups, the best obtainable

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figures as to the number of American insects. The data are tabulated below:

Hymenoptera	10000	Orthoptera	950
Coleoptera	11255	Neuroptera and Pseudoneuroptera	2000
Diptera	9100	Thysanoptera	118
Siphonotera	115	Other small orders	500
Lepidoptera	6622		
Hemiptera	3328		
			43988

A recent catalog of the insects of New Jersey, a state with a considerably smaller area and lacking the climatic and other diversities of New York, lists over 10,000 species. It seems conservative to place the probable number of insect species existing in this State at twice that figure. A thoroughly representative collection of New York forms should therefore contain well toward 20,000 native species, and since each has at least four well-marked stages, some 80,000 different forms. Many species and a great number of the stages are unknown. There is ample work to occupy a well-equipped corps of entomologists in the State Museum for many years, not to mention the much additional labor involved in assembling and maintaining greatly enlarged entomological exhibits.

Nursery inspection. The nursery inspection work conducted by the State Department of Agriculture has resulted in the Entomologist being requested to make numerous identifications and also recommendations in regard to the policy which should be pursued by the State. Many of the specimens submitted for name were in poor condition, and as they may represent any stage in insect development and frequently originate in a foreign country, such determinations are laborious and time-consuming. The correct identification of such material is, however, very important, since the disposition of large shipments of nursery stock must depend, in considerable measure, upon our findings.

Miscellaneous. In cooperation with the Division of Visual Instruction, the Entomologist secured an excellent and somewhat extended series of photographs, mostly of injurious or common insects. This material was all taken in connection with other collecting, it only being necessary to pose the specimen for the photographer.

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VII

REPORT OF THE ZOOLOGIST

The time of the Zoologist and Taxidermist has been occupied chiefly in cleaning, repairing and packing the zoological collections for removal, especially those that were on exhibition in Geological Hall. As it was desired to keep the Museum open to the public as long as practicable, but few of these exhibits had been disturbed during the previous fiscal year, although the duplicate and study collections, with the exception of many of the shells, had been mostly packed. The shell collection was the most difficult to handle on account of the great number of specimens both on exhibition and in storage. As most of the shells were in uncovered paper trays, with loose labels laid upon them, it was important to pack them so that all chance of confusion would be avoided. This work occupied much of the time of the Zoologist and Taxidermist during the entire winter and part of the spring.

The bird and animal groups could not be packed, and it was decided to leave them as they were and have them carefully transported without packing. The single mounted birds and animals were, when not of too great size, packed in boxes by securing the stands to the bottom or sides of the box. When it seemed necessary, the specimen was given additional support to prevent shaking. Those too large to be dealt with in this way were wrapped in several thicknesses of tissue paper which was carefully tied on. In many cases, the specimens were cleaned and repaired previous to packing, but this was not always possible, on account of the large amount of material to be handled. This work had been largely completed by the end of the fiscal year.

The services of Mr C. E. Mirguet, formerly of Ward's Natural Science Establishment, and now in the employ of the United States National Museum at Washington, were obtained for taking apart and cleaning the skeletons of mammals and other vertebrates. The smaller ones were prepared for transportation without entirely disarticulating them, the skull, or the skull and limbs, being removed and packed so as to diminish the danger of breakage. The skeleton of the finback whale, which was hung

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by chains from the beams of the roof in the back wing of Geological Hall, was taken down, entirely taken apart and thoroughly cleaned by Mr Mirguet, and the skeletons of the other large mammals were similarly treated after disarticulating them as much as necessary.

Although the Museum has not been officially open to the public, people desiring to see the collections were not excluded from the exhibition rooms until the dismantling of the exhibits had progressed so far that too little remained to attract visitors, and the spaces in the exhibition rooms were required for the storage of the packed material.

MONOGRAPH OF THE NEW YORK MOLLUSCA

Dr H. A. Pilsbry's work upon the monograph of the New York Mollusca during the year has been directed chiefly to determining the generic characters of numerous forms hitherto inadequately known. To this end, considerable collecting has been done in the Hudson valley, Onondaga county and elsewhere to procure fresh, living material for description. Some forty-five figures of living mollusks have been drawn by the author, including, among others, representatives of the following genera:

Lyogyras	Planorbis	Zonitoides
Amnicola	Segmentina	Gastrodonta
Pomatiopsis	Physa	Helicodiscus
Valvata	Pupilla	Vallonia
Goniobasis	Bifidaria	Arion
Lioplax	Vitrea	etc., etc.
Lymnaea		

The external anatomy of part of these genera has hitherto been known in American works by figures of foreign species copied from European works, or by very crude figures and descriptions. The external soft parts of part of them have not before been figured or described. It is believed that the new facts brought out in the course of this work on American species are ample compensation for the time and labor spent thereon. Further work has been done on the descriptive part, and a large number of illustrations made, figuring all of the species which have been worked up. The completion of the monograph is expected next year (1913).

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VIII

REPORT OF THE ARCHEOLOGIST

The work of the archeology section, as of all other sections of the Museum, has this year been modified to a considerable extent by the necessity of preparing to move its collections and office quarters into the Education Building.

With the close of the fiscal year 1911 the Archeologist had about completed the preliminary work necessary for the exhibition of the Seneca Hunter group, in the ethnological series. A photograph of this group was reproduced in this report last year. With the assured success of the plan for this series of groups depicting Iroquois culture, steps were taken to complete all the preliminary work necessary for the plan.

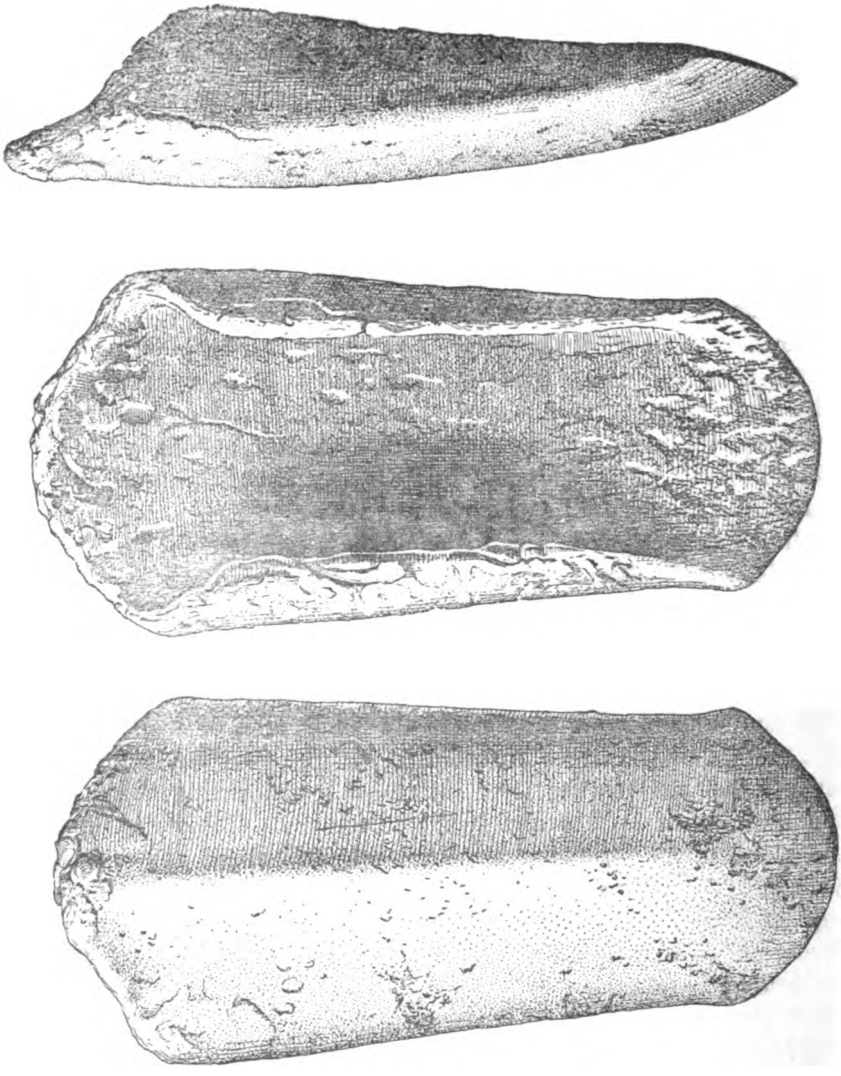
The field painting of the Nichol's pond site was enlarged by Mr D. C. Lithgow, whose artistic ability and skill have been useful. This painting now complete is nearly fifty feet long and eighteen feet high and, like all others, is designed as a background for one of the groups. Further mention of this work will be made in the succeeding pages.

All the collections in the Archeologist's quarters in the Universalist Church building were packed and prepared for moving. It has therefore been impossible to make any further study of this material.

ARCHEOLOGICAL SURVEY

In cooperation with the United States Bureau of Ethnology, this section of the State Museum during the year has sent out several thousand requests for information concerning the sites and remains of former aboriginal occupancy. Reply envelops and blank forms for filling out were sent and about 75 per cent were returned with data filled in. In the majority of cases, these request forms had been sent to the presidents of local boards of education, to library presidents, to county clerks and to collectors, and thus to citizens who were familiar with the localities in which they lived. Several hundred new sites were added to the long list already in the possession of the Museum and will be properly tabulated. This information will not only be of the highest importance to the State Museum, but will form the body of the material used by the Bureau of Ethnology in its "Handbook of Aboriginal Sites and Remains."

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Three views of a copper gouge from Canton, St Lawrence county

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An attempt was also made to make a "census" of all the collections of aboriginal artifacts in the State and a new index has resulted, giving the lists of several hundred collections. In this manner, more than any other, an idea can be obtained of the localities most thickly populated in aboriginal times, but there is seemingly no correspondence between the abundance of earth works and the abundance of specimens. Large numbers of objects from all the various types and successions of occupancy are in the possession of individual collectors. The correspondence and indexing necessary to collect and file these statistics consumed a greater portion of the time up to May, but the knowledge gained is of practical as well as of high scientific importance.

In passing, it should be mentioned that many collections held by private individuals are neither numbered nor adequately cataloged. The collectors almost without exception remember where their objects were found, but without a permanent record the collection is robbed of its highest usefulness, and with the death of the owner, the otherwise valuable and instructive series becomes a mere aggregation of curiosities known as "Indian relics." In these days when the collection of such artifacts has a scientific object, every care should be taken to give each its precise locality. Topographical maps are of much use in this connection.

THE O. W. AURINGER COLLECTION

Supplementing in an important way the Dr A. W. Holden collection, donated last year by State Historian James A. Holden, is the Rev. O. W. Auringer collection, generously donated to the Museum by Dr Albert Vander Veer, of the Board of Regents. This collection is from about the same district as the Holden collection, that is Queensbury township and the region about Troy, north to Lake George.

An examination of the collection donated by Doctor Vander Veer reveals some important archeological facts which, supplemented by Mr Auringer's notes, give the collection a valuable place in our archives. The region from which the collection comes is characterized by several different occupations.

There have been unearthed on several Queensbury sites, flint knives and lance heads so old that the original flint — itself about the hardest of stones — had so far changed in substance as to

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have become chalky white in color, and in some cases so soft as to permit whittling with a sharp knife. Other objects have suffered surface changes from the original dull black of the stone to a lustrous yellow, or buff, or mottled color, according to the difference in soils in which they were imbedded. Such changes in the appearance and structure of flint can come only through exceedingly long and slow processes, and are occasioned by the percolation through soil of water charged with certain chemical elements, the effect upon the stone being the disintegration or final breaking down of one of the two kinds of silica of which it is composed.

The older artifacts occur mainly on a few extensive sites about the southern end of Lake George; at East Lake George; at Glen lake, and on a large site on the eastern town line about half way between Dunham's bay and the Hudson river at Sandy Hill. These sites, which Doctor Beauchamp calls "Early sites," are easily recognized by the initiated, on account of the remains they yield. Massive spear or lance heads, thick and heavy, yet in many cases almost as symmetrical and orderly in construction as if they had been wrought by machinery instead of by hand and eye; knives of flint and fine sandstone, thin and carefully wrought, leaf-shaped in form and edged all around, flaked by unground axes of sandstone and quartzite; acutely edged, finely shaped adzes and gouges of fine sandstone, of hollow and round-backed types; on the waterside sites large flaked disks of coarse sandstone, worked to an edge all around.

Following these traces of earlier men in Warren county, are the rather more broadly-sown of the two succeeding populations of different habits and instincts from their predecessors, and in these same respects also differing quite as much from each other. Our present knowledge in the matter does not definitely justify us in saying which was the earlier of the two, but their large and often curiously decorated pestles and mortars of stone show that they had a knowledge of agriculture. The Eskimo relics discovered point this people as once inhabiting our lands. For the sake of convenience only, we will turn our attention first to the traces of the first-mentioned people, in an endeavor to outline their habitat and realize something of their character and employments. They were agriculturists, huntsmen and fishermen, drawing from soil and forest and lake and river, their means of living. This signifies that they were a people of

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active energy; ambitious, resourceful, with an eye to the main chance — in short, in industrial affairs what the Mohawk was in war. They were inventive, with a decided instinct for art, shown in the decorative effects produced in the manufacture of their weapons and utensils. In their manipulation of stone, they were not satisfied with mere utility. They made an arrow or spear head an object of beauty to the eye, and manifested an accurate taste in the smoothness and symmetry of their pestles when any roughly-dressed stone would have served as well in a practical way. They were makers of pottery, small and large vessels of mingled clay and finely pounded stone, fire-baked and elaborately decorated, though in common with those preceding and following them, they were wholly ignorant of metallurgy.

Beginning at the oft-occupied settlement on the north bank of the Hudson river at the Big bend, we will endeavor to trace the lines of their residence to the northward to Glen lake, thence eastward into Washington county. Here at the rifts of the Hudson are found in the lower layers of soil, quantities of their pottery, celts, knives etc., while all to the north and northwest along Clendon brook and Meadow run, are yearly ploughed up their cylindrical pestles with an occasional mortar. Axes, knives, arrowheads and pottery are found in remarkable quantities. At the southern end of Glen lake, on the plateau where the Glen Lake hotel now stands, was a considerable village stretching thence to the elevated lands on the opposite bank of Meadow run, where that stream enters the lake. Following the western shore of the lake in our survey, we find few traces till we reach the outlet at Butternut flats. Here, on both banks of the creek, which at this point are much elevated, seems to have been an established town, with offshoots in various directions, first to the westward on the small brook near the Halfway house on the highway to Lake George. Then another northwestward, tucked for comfort up under the protection of French mountain, where a cold stream comes down from between the two spurs. Here the writer picked up, among various other objects, an arrowhead of pure transparent quartz crystal. These sites are identified by the fragments of early pottery which they yield. From Glen lake eastward the line of these old habitations follows the stream at intervals through to the Washington county line. Tradition refers to a stone-fortified village at Sanford's bridge, near Halfway brook, which, if tradition is correct, was evidently

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occupied by this people, since the frequent remains found in this neighborhood bear the stamp of their workmanship. A half mile to the eastward of this point, and under the high banks to the right of the Kingsbury road to Sanford's bridge, is a small site yielding large quantities of unworked flints. It would appear that these agriculturists worked the sand plains about the falls of the Hudson, as these two points are within the limits of the city of Glens Falls, which was inhabited; one on the site of the present French Catholic church, which has yielded large pestles, and another back of the city cemetery, and between it and Upper Glen street, producing various flints. That these early inhabitants were frequent visitors at Lake George in quest of game, is evidenced by the location of several of their camps, notably one at the head of the lake and another at Dunham's bay. We could not rationally expect to find here samples of their farming activities, from the nature of the soil, nor do we. But the pottery is in evidence here, showing that, like their white successors, they appreciated the advantages of life and health, which lie in frequent more or less protracted fishing and hunting trips. These small sites — there must be many more of them along the shores and among the islands — were their camps.

Returning to our base as Glen lake, we find traces along the eastern shore; and branching near the head of the lake a line of population followed very nearly by the present line as far south as the neighborhood of De Long's brickyard. Spreading to the east and west, this takes in the famous Blind rock and Hunter's brook tracts with the immediately adjoining territory.

One of the very interesting local problems is the relation of the Eskimos to the region east of Canada and to the former inhabitants of the upper half of New York State — about the Great Lakes, the St Lawrence river and the adjacent smaller streams and lakes. The Eskimos of Point Barrow retain in present use a certain kind of blade or knife of slate, ground and finely polished, in length of three to eight inches, stemmed and usually barbed, sometimes thin and flat, with a narrow bevel to form the cutting edges, often more thick, beveled off from a central longitudinal ridge running the length of the blade. These tools are singular in that no other existing peoples use them, nor from what follows does it seem that any other people ever did use them. In the portion of Canada bordering the Great Lakes, and about the streams and lakes in the

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upper half of the Empire State, many tools of identical character are found in the soil, associated with other objects such as flint arrow points, chipped quartzite blades, and the peculiar form of chipped flint scraper in archeology known as the Eskimo scraper, from its identity with like tools in use by the Eskimo of the north at the present time. Dr William M. Beauchamp, whom we esteem the best authority in archeological matters relating to our State, has furnished an excellent study of these remains; and he seems unhesitating in his belief that at some period quite remote, the regions about and to the northward of us were the established homes of the tribes now inhabiting the far north, known as the Eskimos. The truth would appear to be, that this was their home at a remote period, when the climate retained considerably more of arctic severity than is known at present; and that, following the receding cold upon the gradual encroachment of warmer conditions, and the migration of the cold-loving animals upon which they subsisted, they tended gradually northward till they at length found in the utmost north the favorite conditions of their well-being. Their chief habitat in the town of Queensbury was about Glen lake. There, at the northern end, or outlet, was a large, permanently established town covering many acres, from which ran lines of habitation in various directions: first northward under the base of French mountain for a distance, then striking off to East Lake George, where, as we might expect, there was a large village; second, a shorter line, comprising three small sites, with its terminus at Lake Sunnyside. Here, on the abrupt hill on the west shore of the lake was one of their lake dwellings. In the collection from Queensbury just donated by Dr Albert Vander Veer, is a card of several specimens of the "polished slate knife," among which is one obtained from the Washburn farm at French mountain, about a mile from Glen lake. It is made from Kingsbury banded red and gray slate, the red predominating, is of lance-head form, seven inches in length, by about one inch in mean breadth, has a central longitudinal ridge on each surface, is acutely pointed, with sharp edges. The stem is notched and there are well-defined barbs. With one exception this is the finest object of its kind among the one hundred and odd specimens so far reported. Saratoga lake has furnished a few of these knives, and two specimens have been discovered at Marcy, in Oneida county. They are

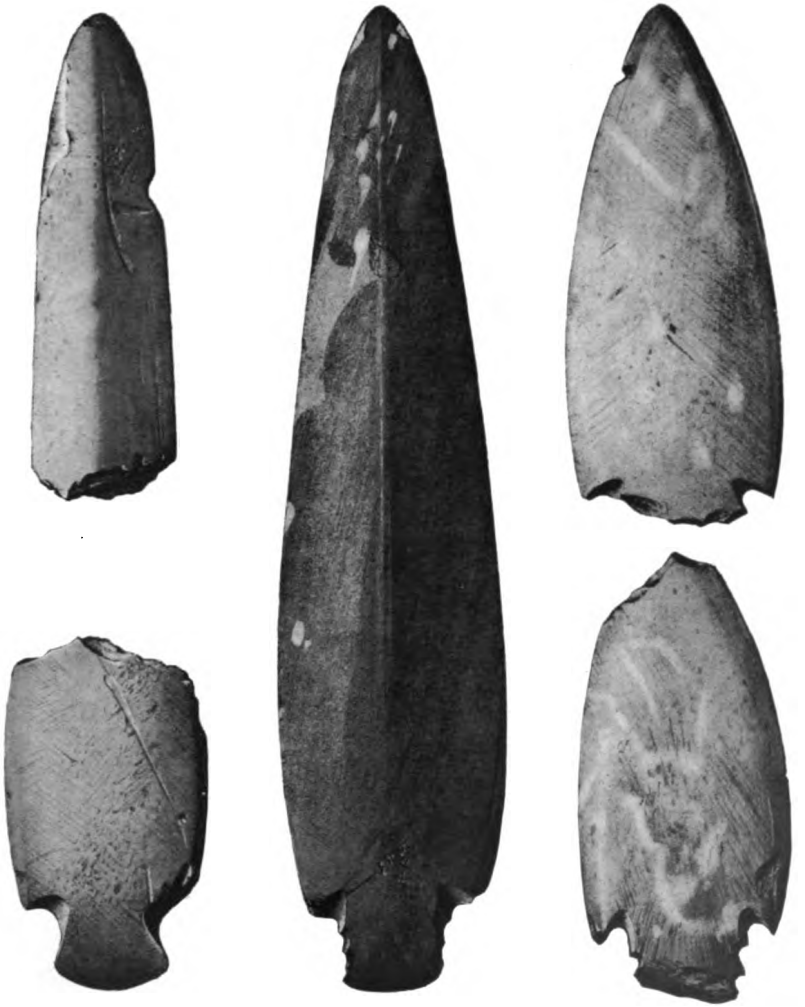
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rather more common about Lake Ontario and the neighborhood of Oneida lake than on the two sites just named. Prof. D. F. Thompson of Troy obtained one from the Bolton shore of Lake George; and from Lake Champlain, as we might expect, come a few others. A single specimen, the largest, but also the rudest in point of finish yet reported, comes from the Maine lakes.

Exactly what took place here at the close of the period we have been considering we do not know. But, by means of the alphabet of relics, supplied by the superficial soil, we are able to spell out a period of great confusion. The country here seems to have been overrun from about every quarter, judging from the pattern and material, foreign to the locality, of relics scattered so profusely about our fields. Flint from Ohio and farther west; copper from Michigan; grooved axes and soapstone pottery from the Atlantic tract; opaque quartz, and even obsidian, from the south — all these meet and dispute for the notice of the archeologist on Queensbury ground. At Assembly point, on Lake George, is a site yielding beaten copper spear and arrowheads. In Mr Auringer's explorations, he found a large grooved and polished limestone axe from the often-occupied site in Harrisena; and in line of association, fragments of large steatite, or soapstone pottery, have been taken from a site southwest of Glens Falls by a local collector. This signifies the presence in the intermediate period of the New England Algonquins. On Harrisena site again are found broad, thin and symmetrical polished limestone celts of quite other origin than the axes. How long the season of confusion lasted, it is impossible to know.

The territory including Queensbury was in the Algonquins' hands when the Europeans appeared on the scene. Having driven out the Iroquois, they ruled once more undisturbed in their ancient habitat. The Iroquois had gone down by two principal routes to the Mohawk valley, where they had already, prior to the advent of the whites, formed their powerful Confederacy. One of these routes was by the St Lawrence and Lake Ontario. The other was by the Champlain and Lake George trail to the Hudson river, and thence to the mouths of the Mohawk. It is possible to trace their line of migration from Dunham's bay southeastward to the county line and on to the Hudson at Hudson Falls. The first stage of this overland exodus is well marked by the remains of a considerable town situated on the flats bordering the inlet at Dunham's bay. From this point

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Slate knives, probably of Eskimo origin from Glen lake, Saratoga county. Auringer-Vander Veer collection.

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the trail ran southeasterly for some miles (a day's journey for an Indian) to a station on the county line road lying about the sources of Cold brook. Here the remains of occupancy are spread over many acres, and encroach upon and partly cover a permanent village site of the earliest inhabitants, whose remains have already been described. The relics of these two sites are exactly of the same character as those from Iroquoian stopping places on their westernmost route by way of the St Lawrence. They consist of fragments of the well-known clay pottery of the Mohawk tribes; pipes of red pottery; small triangular flint arrowheads; acutely edged celts and a few small flint knives.

A few years ago there was found on the site of the big bend a fine specimen of the steel "trade axe" with which the traders first armed their red neighbors. This is included in this collection and is in a fine state of preservation. There is also a fine and keen steel arrow and shaft, obtained from a site at the western base of Sugar Loaf mountain. Objects of copper have been found at the same place. A broken stone pipe drilled with steel tools of the white man comes from Glen lake. On the Bay road, on the farm owned by Elber Titus, was a Mohawk camp of late date. In addition to the small flint implements supplied by such stations, this field yielded one of the choicest objects of Mohawk manufacture which it has been my good fortune to record. It is a flat limestone pebble three inches in mean diameter, carved into the form of a young buck's antlers, and perforated at one side near the base for the purpose of suspension. Both surfaces are delicately carved into ridges, giving a corrugated appearance. It belongs to a class of objects termed personal ornaments. About Lake George and on many of its islands are frequent finds of Mohawk relics made. But the Mohawk never returned to occupy the country as a permanent residence. What we find of him here are but the remains of these temporary hunting or war camps, for he was often attracted this way from his home on the "Beautiful river," by the scent of game or scalps; but it was only as an intruder that he came.

In their manufacture of stone implements, the aborigines used such material as was found in their neighborhood. Where supplies of flint were lacking, they made use of native quartzite and even sandstone for their smaller weapons, as arrowheads, knives, and spear points, as well as for heavier tools. These native supplies

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they supplemented with flint in the block obtained by way of trade with neighbors occupying a flint-producing region. In Queensbury, we find the occupants of all periods using the local quartzite pebbles freely for long axes, celts, or hand axes, the larger class of spears and knives, and scrapers; while the local sandstones supplied the place of harder material for certain gouges and adzes. Laminae of fine sandstone served for the manufacture of finely wrought knives and lanceheads. The Eskimo worked the silex, or white flint deposit, on French mountain for material in the manufacture of large knives and spears, and even small arrowheads, while the neighboring slate quarries of Washington county served him in the matter of material for slate knives, ground and unground. And certain ceremonial stones, as the perforated gorget, bird and bar amulet, and often a banner stone, used by his predecessors, were of the same material. Many chisels and axes were made of the black limestone of the region, which was a favorite on account of the high polish it takes. Greenstone and conglomerate pebbles were utilized for celts and banner stones. At the foot of Glen lake was found a thick celt, or hand axe, of brown hematite, or ironstone. Hornstone and various flints often occur in limestone deposits; and doubtless the native miner understood the location of material of such value to him, in these eastern tracts. Nevertheless much flint in the rough must have been brought in from the western sources.[1]



Typical gouge from Warren county

ARCHEOLOGICAL COLLECTIONS

Among other interesting objects are a series of flints from Green Island and a semilunar or woman's knife from the mouth of the Hoosic river. This latter object was donated to the Museum by Mr Albert Hurd, of Troy, and represents one of the largest semilunars found in this region. It is a rare and valuable specimen and its donor is entitled to special thanks. A representation of this knife is shown in the accompanying figure.

[1] See N. Y. State Hist. Rept. by Auringer, 8: 102–12.

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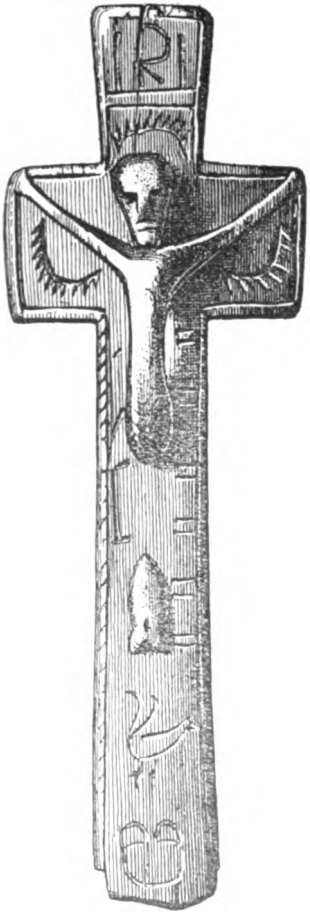


Semilunar knife from mouth of Hoosic river. Donated by Albert S. Hurd

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An important mound was excavated during the year by Mr E. R. Burmaster, and a fine type of a mound skull obtained. This mound is in Chautauqua county and is one of the largest of its kind in the State.

A unique acquisition and addition to our collection of early religious objects is a crucifix obtained by Miss Pearl Hoppel in an old farmhouse at Fallsburg. It was evidently made by some Delaware or Minsi Indian in the early days and indeed has two totem animals of the Minsi carved upon it. The accompanying figure shows a representation of this object.



Crucifix probably carved by Minsi Indians. From Fallsburg, N. Y.

FOLKLORE

The study of the Iroquois rites and folklore was continued with much success. Valuable additions were made to the notes on the wampum codes and condolence ceremony. Mr Albert Cusick, long the helper of and coworker with Dr William M. Beauchamp, and previously the interpreter for Horatio Hall, was of much assistance in this connection. Mr Cusick is an Onondaga by birth and has long been regarded by the Onondagas, and indeed by all the Six Nations in New York, as their greatest authority on the council rites of the League of the Iroquois. In October, a few weeks after the Archeologist had completed his notes on tree symbols and myths, Mr Cusick died. This serves as a reminder of the fact that speedy work must be done if any amount of information is to be recorded. With the death of Chief John Gibson, of the Six Nations of Ontario, in October, another native annalist passed beyond reach. Mr Gibson had also been of considerable assistance to this section of the Museum.

With the corrections made by Chief Edward Cornplanter on the Code of Handsome Lake, the Seneca prophet, a manuscript

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version of the teachings of the celebrated Seneca chief, the manuscript was revised and with explanatory notes and appendixes, was submitted as a bulletin in the Museum archeological series. This work, now in press, will be a free translation of the religious belief of the modern nonchristian Iroquois of New York and Ontario, and should prove a work of some psychological as well as sociological and ethnological interest. It was Handsome Lake who revolutionized in sixteen years the disintegrating Seneca and Onondaga tribes and recrystalized their native beliefs. This was accomplished at a critical moment in the history of the Iroquois — immediately after the Revolutionary War, when the Iroquois League was broken and disheartened. Handsome Lake's teachings gave a new life and a new hope. The bulletin will be no. 16 in the archeological series.

PUBLIC INTEREST

Public interest in the work of the archeological section is attested by the large number of letters of inquiry which have come to this office and the many requests for information.

To museum authorities, especially, the plan for the ethnological groups has made an appeal, and a considerable number have visited the workshops for information as to methods.

IX

PUBLICATIONS

A list of the scientific publications issued during the year 1911–12, with those now in press and treatises ready for printing, is attached hereto. The publications issued cover the whole range of our scientific activities. They embrace 926 pages of text, 122 plates and 19 maps.

The labor of preparing this matter, verifying, editing and correcting is onerous and exacting. Taken altogether, it excellently indicates the activity and diligence of the staff of this division.

ANNUAL REPORT

1 Eighth Report of the Director, State Geologist and Paleontologist for the fiscal year ending September 30, 1911. 218p. 42 pl.

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Contents:

Introduction
I Condition of the scientific collections
II Report on the geological survey
Some practical features of New York geology
Areal geology
Surficial geology
Industrial geology
Seismologic station
Mineralogy
Paleontology
III Report of the State Botanist
IV Report of the State Entomologist
V Report of the Zoologist
VI Report on the archeology section
List of archeological specimens destroyed in the Capitol fire, March 29, 1911
VII Publications
VIII Staff
IX Accessions
Notes on the Geology of the Gulf of St Lawrence. J. M. CLARKE
Notes on Devonic Fishes from Scaumenac. L. HUSSAKOF
Notes on a Specimen of Plectoceras jason (Billings). RUDOLF RUEDEMANN
On the Genesis of the Pyrite Deposits of St Lawrence County. C. H. SMYTH, JR
Recent Mineral Occurrences in New York City and Vicinity. H. P. WHITLOCK
The Micmac Tercentenary. JOHN M. CLARKE
The Manhattan Indians. ALANSON SKINNER
Index

BULLETINS

Geology

2 No. 153 Geology of the Broadalbin Quadrangle. By W. J. Miller. 1911. 66p. 8pl. 1 map.

Contents:

Introduction
General geography and geology
Precambric rocks
Paleozoic rocks
Faults
Physiography
Summary of geologic history
Economic products
Index

3 No. 154 Glacial Geology of the Schenectady Quadrangle. By James H. Stoller. 1911. 44p. 9pl. 1 map.

Contents:

Introduction
Topography due to rock surfaces
Modifications of rock topography during Pleistocene period
Surface deposits
Economic values of the Lake Albany deposits
Modified till
Recent deposits
Review and summary
Index

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4 No. 159 The Mineral Springs of Saratoga. By James F. Kemp. 80p. 3pl. 1912.

Contents:

Introduction
Historical sketch
Brief statement of the local geology
The fault at Saratoga Springs
Generalities regarding the normal ground waters
Composition and character of the Saratoga waters
Carbon dioxid
Water seal
Temperature of the waters
Specific gravity of the waters
Classification
Variations in the waters
Origin of the mineral waters
Tables of analyses
Index

5 No. 160 Glacial Waters in the Black and Mohawk Valleys. By H. L. Fairchild. 48p. 8pl. 17 maps.

Contents:

Introduction: outline of glacial history
Black valley glacial waters
Physiography
Outline of lake history
First stage: Mohawk waters; Herkimer lake
Second stage: Forestport lake; Remsen outlet
Third stage: Port Leyden lake; Boonville outlet
Fourth stage: Glenfield lake; Copenhagen-Champion outlet
Fifth stage: Lake Iroquois
Pre-Wisconsin topography
Mohawk valley glacial waters
First stage: early Adirondack drainage
Second stage; Herkimer lake
Third stage: Schoharie lake
Fourth stage: Amsterdam lake
Fifth stage: Lake Albany
Tributary lakes
Rock barrier at Little Falls
Divide at Rome
Summary of Mohawk drainage history
Correlation of Ontarian and Hudsonian Ice Lobes
Bibliography
Index

6 No. 161 Mining and Quarry Industry of New York. By D. H. Newland. 114p.

Contents:

Introduction
Mineral production of New York
Cement
Clay
Production of clay materials
Manufacture of building brick
Other clay materials
Pottery
Crude clay
Emery
Feldspar
Notes on the occurrence of feldspar in New York
Garnet
Graphite
Gypsum
Iron ore
Mineral paint
Mineral waters
Natural gas

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Contents —(Continued):

Petroleum
Pyrite
Salt
Sand and gravel
Sand-lime brick
Stone
  Production of stone
  Granite
  Limestone
  Marble
  Sandstone
  Trap
Talc
  The Gouverneur talc district
Zinc
Index

Entomology

7 No. 155 Report of the State Entomologist for the fiscal year ending September 30, 1911. 182p. 35pl.

Contents:

Introduction
  Injurious insects
    Codling moth
    Gipsy moth
    Green maple worm
    Iris borer
    Notch wing
    Maple leaf cutter
    Locust leaf miner
    Rosy Hispa
    Rose leaf hopper
    Periodical Cicada
  A report upon the condition of the shade trees of the city of Mount Vernon, N. Y.
  Experiments with heat as an insecticide
  Notes for the year
    Fruit tree insects
    Small fruit insects
    Shade tree pests
    Forest pests
    Miscellaneous
  Publications of the Entomologist
  Additions to collections
  Explanation of plates
  Index

8 No. 156 Elm Leaf Beetle and White-Marked Tussock Moth. By E. P. Felt. 35p. 8pl.

Contents:

Introduction
Elm leaf beetle
  Results of attack
  Food plants
  Distribution
  Description
  Life history
  Natural enemies
  Preventive measures
  Remedial measures
White-marked tussock moth
  Description
  Life history and habits
  Food plants
  Natural enemies
  Remedies
Explanation of plates
Index

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Botany

9 No. 157 Report of the State Botanist for the fiscal year ending September 30, 1911. 139p. 9pl.

Contents:

Introduction
Plants added to the herbarium
Contributors and their contributions
Species not before reported
Remarks and observations
New species and varieties of extralimital fungi
Edible fungi
New York species of Clitocybe
New York species of Laccaria
New York species of Psilocybe
Latin descriptions of new species and varieties
Explanation of plates
Index

GEOLOGIC MAPS

10 Broadalbin quadrangle
11 Schenectady quadrangle

In press

MEMOIRS

12 Birds of New York, volume 2
13 Eurypterida of New York

BULLETINS

Geology

14 The Geological History of New York State

Paleontology

15 The Lower Siluric Shales of the Mohawk Valley

Entomology

16 Report of the State Entomologist for the fiscal year ending September 30, 1912

Botany

17 Report of the State Botanist for the fiscal year ending September 30, 1912

Archeology

18 The Code of Handsome Lake, the Seneca Prophet

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X

STAFF OF THE SCIENCE DIVISION AND STATE MUSEUM

The members of the staff, permanent and temporary, of this division as at present constituted are:

ADMINISTRATION

John M. Clarke, Director
Jacob Van Deloo, Director's clerk
Paul E. Reynolds, Stenographer

GEOLOGY AND PALEONTOLOGY

John M. Clarke, State Geologist and Paleontologist
David H. Newland, Assistant State Geologist
Rudolf Ruedemann, Assistant State Paleontologist
C. A. Hartnagel, Assistant in geology
Robert W. Jones, Assistant in economic geology
D. Dana Luther, Field geologist
Herbert P. Whitlock, Mineralogist
George S. Barkentin, Draftsman
H. C. Wardell, Preparator
Michael Sammon, Stenographer
Charles P. Heidenrich, Machinist
Joseph Bylancik, Page

Temporary experts

Areal geology

Prof. H. P. Cushing, Adelbert College
Prof. J. F. Kemp, Columbia University
Dr C. P. Berkey, Columbia University
G. H. Hudson, Plattsburg State Normal College
Prof. W. J. Miller, Hamilton College
Dr W. O. Crosby, Massachusetts Institute of Technology
Dr H. B. Kümmel, Trenton, N. J.

Geographic geology

Prof. Herman L. Fairchild, Rochester University

Paleontology

Edwin Kirk, Washington, D. C.

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BOTANY

Charles H. Peck, State Botanist
Stewart H. Burnham, Assistant

ENTOMOLOGY

Ephraim P. Felt, State Entomologist
D. B. Young, Assistant State Entomologist
Fanny T. Hartman, Assistant
Anna M. Tolhurst, Stenographer
J. Shafer Bartlett, Clerk

ZOOLOGY

Willard G. Van Name, Zoologist
Arthur Paladin, Taxidermist

Temporary experts

Prof. E. Howard Eaton, Canandaigua
Dr H. A. Pilsbry, Philadelphia

ARCHEOLOGY

Arthur C. Parker, Archeologist

Temporary assistant

Howard A. Lansing, Albany

XI

ACCESSIONS

ECONOMIC AND GENERAL GEOLOGY

Collection

Newland, D. H. Albany

Building stones, rough and polished samples	25
Zinc and pyrite ores, St Lawrence county	20
Diabase dikes cutting granite, Dannemora, N. Y.	3

Donation

Uniform Fibrous Talc Co. Talcville

Exhibit of crude and ground talc	10

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PALEONTOLOGY

Donation

Eastman, Dr Charles R. Washington, D. C.
Plaster restorations of Bunodes, Pterichthys and Cladoselache 3

Landreth, William B. Deputy State Engineer, Albany
Mammoth tooth found while excavating for lock 26, on the barge canal, near Clyde, N. Y. 1

Van Horne, C. F. Glen
Concretions from Schoharie creek, at Glen (Montgomery co.) containing Utica slate fossils. 32

Exchange

Mathes, K. B. Batavia
Devonic fossils from various localities in Genesee county. . 125

Purchase

Plourde, Anthony. Migouasha West, P. Q.
Devonic fishes from Migouasha, P. Q. 120

Collection

Hartnagel, C. A.
Siluric fossils from Black Cape, P. Q. 1200

Ruedemann, R.
Fossils from Schuylerville sheet, Aries lake, Hyde Park, Schodack Landing 125

ENTOMOLOGY

Donation

Hymenoptera

Lewis, G. C. Lockport. Thalessa atrata Fabr., black long sting, adult. June 17

Dummett, Arthur. Mount Vernon. Apanteles congregatus Say, cocoons and adults, July 29

DeLong, E. W. Crown Point. Same as preceding, on Ampelophaga myron Cram., August 7

Mc Atee, W. L. Pickens, Miss. Cynips strobilana O. S., lobed oak gall, October 12. Also Neuroterus umbilicatus Bass., oak button gall on Quercus michauxii, October 12

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Laney, C. C. Rochester. Andricus seminator Harr., wool sower, gall on white oak, June 21

Sherman, Miss Ruth H. Glens Falls. Same as preceding, June 24

Taylor, R. M. Ann Arbor, Mich. Neuroterus saltatorius Hy. Edw., galls on white oak, July 24

Blunt, Miss E. S. New Russia. Cimbex americana Leach, elm sawfly, larva on elm, September 20

Woodward, A. G. Through State Conservation Commission. Tremex columba Linn., pigeon tremex, adult, September 11

Brooks, E. C. Athens. Caliroa cerasi Linn., pear slug, larvae on pear, August 12

Robson, A. N. Lake George. Kaliofenusa ulmi Sund., elm leaf miner, larva on elm, June 13

Rutledge, Neil. Greenwich. Same as preceding, June 15

Devereaux, W. L. Syracuse. Same as preceding, June 19

Ward, J. G. Cambridge. Same as preceding, larvae and work on elm, June 24

Vail, Harry. New Mulford. Trichiocampus viminalis Fall., larvae, August 29

Coleoptera

Matheson, W. J. Huntington. Eccoptogaster quadrispinosa Say, hickory bark beetle, work on hickory, February 9

Merkel, H. W. New York City. Same as preceding, larvae and work, March 12 and June 17

Anderson, E. H. Scarsdale. Same as preceding, work, June 22

de Vyver, J. J. Mount Vernon. Same as preceding, adults and work, July 1

Dwyer, F. P. Yonkers. Same as preceding, work, July 30

Chapman, J. W. Dorchester, Boston, Mass. Eccoptogaster multistriata Marsh, imported elm bark borer, adults and larvae, October 5

Vitale, Ferruccio. New York City. Pissodes strobi Peck, white pine weevil, work on pine, July 11

Cunningham, Thomas. Vancouver, B. C. Thricolepis simulator Horn, gray, bark-eating weevil, adult on apple, May 2

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Herrick, C. J. Elsmere. Pomphopoea sayi Lec., Say's blister beetle, adults on wild cherry, May 31

Hawley, G. H. Castleton. Coptocycla ? clavata Fabr., larva on morning glory, July 9

Gardner, M. H. Brewster. Galerucella luteola Müll., elm leaf beetle, adults, April 18

Crittenden, Mrs W. H. Cornwall. Same as preceding, May 10

Young, J. T. Watervliet. Same as preceding, eggs on elm, June 14

Gaskell, A. Ellenville. Same as preceding, adults, larvae and pupae on elm, July 11

Tate, L. A. Gloversville. Same as preceding, larvae and work on elm, July 16

Cook, W. M. Oyster Bay. Same as preceding, work on elm, August 5

Cunningham, Thomas. Vancouver, B. C. Glyptoscelis alternata Cr., leaf beetle, adult on apple, May 2

Rooney, J. O. Scarsdale. Elaphidion villosum Fabr., oak and maple pruner, larva and work on oak, July 24

Chatham Courier. Chatham. Monohammus confusor Kirby, sawyer, adult, July 10

Wend, Mrs George. Albany. Same as preceding, adult on pine, July 17

Bender, Matthew, jr. Niverville. Lachnosterna, June beetle, larva in grass sod, August 11

Woodward, W. M. North Chatham. Same as preceding, August 11

Moore, R. M. Rochester. Psephenus lecontei Lec., larva, September 25

Van Name, W. G. Albany. Dermestes vulpinus Fabr., leather beetle, all stages, March 26

Bernstein, Charles. Rome. Megilla maculata DeG., spotted lady-beetle, adults, December 13

Diptera

McAtee, W. L. Marksville, La. Thecodiplosis ananassi Riley, galls on Cypress, September 12

Dale, G. L. Mount Kisco. Caryomyia caryae O. S., gall on hickory, July 22

Rooney, Mrs J. O. Scarsdale. Same as preceding, July 24. Also Caryomyia persicoides Beutm.

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Albright, Thomas. New Baltimore. Contarinia pyrivora Riley, pear midge, larvae on pear, May 27

Baker, C. F. Claremont, Cal. Asphondylia betheli Ckll., male, female, larva and pupa on Opuntia, April

Bethel, E. Denver, Col. Same as preceding, gall, male and female on Cactus, May 22

Rhines, W. D. Linlithgow. Simulium sp., blackfly, larvae, June 19

Bernstein, Charles. Rome. Eristalis tenax Linn., bee fly, larvae, August 27

Gillett, J. R. Kingston. Musca domestica Linn., housefly, larvae from cases of Myiasis interna, September 9

Amundsen, E. O. San Diego, Cal. ?Agromyza sp., adult on Wisteria buds, March 23

Lepidoptera

Principal, Schoharie High School. Schoharie. Through State Department of Agriculture. Polygonia? comma Harr., hop merchant, eggs on hop, June 5

Delafield, Mrs I. D. F. Greenport. Euvanessa antiopa Linn., spiny elm caterpillar, larva on elm, June 25

Sweigert, J. A. Comstock. Same as preceding, July 1

Dodge, J. H. Rochester. Sphecodina abbotii Swain, larva on woodbine, July 10

Dummett, Arthur. Mount Vernon. Same as preceding, July 29

De Long, E. W. Crown Point. Ampelophaga myron Cram., grapevine hog caterpillar, larva on grape, August 7

Gaut, H. Glen Cove. Samia cecropia Linn., Cecropia moth, cocoon, December 28

Jackson, Mrs A. M. A. Warner. Telea polyphemus Cram., American silk worm, eggs, June 6

Wilbor, Miss M. R. Old Chatham. Callosamia promethea Dru., Promethea moth, cocoons, May 10

Martin, Mrs Martha W. Albany. Same as preceding, larvae on lilac, August 5

Worman, A. E. Fillmore. Through State Conservation Commission. Diacrisia virginica Fabr., Virginia ermine moth, adult, June 20

Strickland, L. F. Lockport. Through State Department of Agriculture. Arctia caja Linn., garden tiger moth or woolly bear of Europe, larva, October 26

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Woolworth, C. C. Castleton. Alypia octomaculata Fabr., eight-spotted forester, larva on woodbine, July 10

Mostow, Robert. New York City. Laphygma frugiperda Sm. & Abb., fall army worm, larvae and pupae on lawn, September 11

Latham, Roy. Orient Point. Same as preceding, September 11

Parsons, Samuel. New York City. Same as preceding, September 11 and 21

Niles, T. F. Chatham. Agrotis ypsilon Rott., black cutworm, larva, June 10

Rogers, F. E. Oswego. Mamestra picta Harr., zebra caterpillar, larvae on pear, July 16

Bird, Henry. Rye. Papaipema appassionata Harvey, P. necopina Grt., P. frigida Sm., P. sciata Bird, P. inquaesita G. & R., P. maritima Bird, P. rigida Grt., P. marginidens Gn., P. moeseri Bird, P. duplicata Bird, P. cerussata Grt., P. duovata Bird and Apamea erepta var. graminea Bird, August 14

Bailey, G. W. Geneseo. Alabama argillacea Hübn., cotton moth, adults, October 9

Mosher, H. J. New Berlin. Same as preceding, October 11

Bishop, I. P. Buffalo. Same as preceding, October 13

Green, A. H. Shushan. Catocala sp., caterpillar, June 19

Richardson, M. T. New York City. Datana integerrima Grt. & Rob., black walnut worm, larvae on English walnut, August 5

Smith, C. H. Mohegan Lake. Same as preceding, caterpillars, August 22

Wiltse, J. W. North Chatham. Schizura concinna Sm. & Abb., red-humped apple caterpillar, larvae on apple, July 9

Dodge, J. H. Rochester. Tolype laricis Fitch, larch lappet moth, larva, August 8

Coventry, T. L. Utica. Malacosoma americana Fabr., apple tent caterpillar, larvae, June 12

Matthews, P. B. Bridgehampton. Through State Department of Agriculture. Same as preceding, larvae on oak, June 19

Whitcomb of The Commonweal. Greenwich. Same as preceding, adult, July 7

Chahoon, George. Ausable Forks. Same as preceding, cocoons, July 13

Hicks, Isaac & Son. Westbury. Malacosoma disstria Hübn., forest tent caterpillar, larvae, June 10

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Worman, A. E. Fillmore. Through State Conservation Commission. Same as preceding, larvae, June 20

Vosburgh, G. C. Moravia. Eranis tiliaria Harr., basswood inch worm, larvae on elm and basswood, June 8

Brown, Miss Helen A. Brooklyn. Thyridopteryx ephemeraeformis Haw., bagworm, larvae on purple beech, August 2

Felten, G. R. Cementon. Sibine stimulea Clem., saddleback caterpillar, September 3

Mulholland, J. B. Kingston. Same as preceding, larvae on blackberry, September 24

Hicks, Isaac & Son. Westbury. Zeuzera pyrina Linn., leopard moth, work on hickory, October 26

Mulligan, E. T. New York City. Through State Department of Agriculture. Same as preceding, larva, December 24 and 27

Lobdell, Miss Mary L. Woodhaven. Same as preceding, larva, March 17

St John, C. L. Canajoharie. Mineola indigenella Zell., leaf crumpler, larval cases, February 24

Stevens, Ogden. Albany. Ephestia cautella ? Walk., larvae and adults on English walnuts, November 20

Smith, W. F. Valhalla. Evetria ? frustrana Comst., caterpillar on pine, August 30

Fernald, H. T. Amherst, Mass. Evetria ? comstockiana Fernald, pitch twig moth on pine, June 12

Scofield, R. Coeymans. Tmetocera ocellana Schiff., bud moth, larvae in pear buds, May 8

Emmons, G. E. Schenectady. Tortrix fumiferana Clem., spruce bud moth, larvae on spruce, June 3

Weld, F. M. New York City. Coleophora caryaefoliella Clem., larvae and work on hickory, July 13

Evans, Cadwallader. Stellarton, Nova Scotia. Bucculatrix canadensisella Cham., birch leaf skeletonizer, molting cocoons, August 29. Also larvae, cocoons and work on birch, September 18

Harrison, David. Staatsburgh. Phyllonoryter hamadryella Clem., oak blotch leaf miner, mines on oak, July 29

Wier. Miss Anne R. Garrison. Same as preceding, work on oak August 5

Clark's Sons, D. Fordam Heights, New York City. Through State Department of Agriculture. Gracilaria near violacella Busck, larvae on azalea, March 7

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Neuroptera

Nixon, I. L. Rochester. Corydalis cornuta Linn., horned Corydalis, adult, July 1

Thysanoptera

Ward, G. E. Ravena. Euthrips pyri Dru., pear thrips, adults on apple, May 1

Hemiptera

Bailey, G. A. Geneseo. Tibicen septendecim Linn., seventeen-year Cicada, adult and pupal case, June 14

Dodge, J. H. Rochester. Cicada ? linnei Grossb., harvest fly, adult, August 26

Buchholz, A. B. Geneva. Through State Department of Agriculture. Phylloxera caryaecaulis Fitch, hickory gall aphid, old galls on hickory, October 26

Armer, H. N. Ballston Spa. Through State Conservation Commission. Chermes pinicorticis Fitch, pine bark aphid, adults on pine, July 5

Judson, W. P. Broadalbin. Same as preceding, July 12

Duhamel, M. F. Poughkeepsie. Same as preceding, August 8

Baker, A. M. Oneonta. Hormaphis hamamelidis Fitch, witch-hazel cone gall, galls on witch-hazel, August 5

Banks, Mrs R. S. Albany. Pemphigus populi-transversus Riley, gall and young on poplar, June 18

Olsen, C. E. Maspeth, L. I. Schizoneura americana Riley, woolly elm leaf aphis, young on elm, June 18

Hareford, Miss Alice C. Watertown. Same as preceding, adults and young on elm, June 21

Fuller, A. R. Malone. Same as preceding, adults and work on elm, July 18

Niles, Mrs S. H. Coeymans. Schizoneura lanigera Hausm., woolly apple aphis, young on apple, November 8

Delehanty, J. A. Albany. Same as preceding, nymph on apple, August 26

Marshall, D. T. Hollis. Chaitophorus aceris Linn., work and young on Norway maple, July 6

Gibson, W. W. Watervliet. Same as preceding, nymphs on Norway maple, July 11

Waterman, R. S. Ogdensburg. Callipterus ulmifolii Mon., elm leaf aphis, adults on elm, July 1

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Barrus, G. L. Paul Smiths. Mindarus abietinus Koch., work on balsam, July 1

Latham, Roy. Orient Point. Aphis nasturtii Kalt., adults and nymphs on nasturtium, October 3

Brock, J. G. Binghamton. Gossyparia spuria Mod., elm bark louse, males and females on elm, May 29

Cockerell, T. D. A. Boulder, Col. Eriococcus borealis Ckll., adults, October 7

Hessberg, Samuel. Albany. Phenacoccus acericola King, false maple scale, males on maple, June 11

Cockerell, T. D. A. Glenwood Springs, Col. Trionymus violascens Ckll. (part of type), adult on Agropyron, October 2

Olsen, C. E. Maspeth. Pseudococcus citri Risso, mealy bug, adult, July 20

Marshall, D. T. Hollis. Pulvinaria vitis Linn., cottony maple scale, adults and young on soft maple, July 6

Tioga county. Through State Department of Agriculture. Lecanium sp., Lecanium scale, adult and young on Tecoma radicans, November 1

Carpenter, E. E. Morris. Same as preceding, adults on oak and chestnut, June 8

Woodlawn Cemetery. New York City. Through State Conservation Commission. Asterolecanium variolosum Ratz., golden oak scale, adult, June 14

Livingston, J. H. Tivoli. Toumeyella liriodendri Gmel., tulip tree scale, young on tulip tree, February 12

Harris, A. G. North Pelham. Same as preceding, adults on tulip, July 29

Thomson, Miss Annis E. Yonkers. Same as preceding, July 29

Clark, S. M. Warrensburg. Eulecanium ? canadense Ckll., adults on elm, May 27

Van Aken, Silvanus. Port Ewen. Eulecanium ? persicae Fabr., peach scale, adults and eggs on crimson rambler rose, June 17

Lown, Mrs Robert. Idlewild. Same as preceding, July 2

Heavey, J. Buffalo. Chionaspis furfura Fitch, scurfy scale, eggs, March 5

Levison, J. J. Brooklyn. Chionaspis americana Johns., elm scurfy scale, egg on elm, February 6. Also Chionaspis pinifoliae Fitch, pine leaf scale, egg on Austrian pine, February 6

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Duff, Mrs Harriet A. Kinderhook. Chionaspis pinifoliae Fitch, adults on pine, September 16

Through State Department of Agriculture. Rochester. Diaspis carueli Targ.-Tozz., juniper scale on juniper, May 16

Heavey, J. Buffalo. Aspidiotus perniciosus Comst., San José scale, young, March 5

Williams, C. L. Glens Falls. Same as preceding, May 24

Stone, D. D. Oswego. Aspidiotus ancylus Putn., Putnam's scale, half grown, April 19

Latham, Roy. Orient Point. Chrysomphalus aonidum Linn., rubber scale insect, adults on rubber plant, April 22

Gaut, H. Glen Cove. Lepidosaphes ulmi Linn., oyster shell scale, egg on willow, December 28

Heavey, J. Buffalo. Same as preceding, eggs, March 5

Henkes, Fred. Watervliet. Through State Department of Agriculture. Same as preceding, old scales on apple, May 11

Hasbrouck, Levi. Ogdensburg. Same as preceding, June 22

Olsen, C. E. Maspeth. Same as preceding, adults on white birch, July 20

Through State Department of Agriculture. Schenectady. Parlatoria theae Ckll., adult on Japanese maple, April 25

Overton, Miss Lillian C. Albany. Haematopinus piliferus Burm., sucking dog louse, adults on dog, April 8

St John, C. L. Canajoharie. Blissus leucopterus Say, chinch bug, adults and young, September 26

Buchman, Edwin. Valley Falls. Acholla multispinosa DeG., spined assassin bug, nymph, August 13

Briggs, G. J. Macedon. Cimex lectularius Linn., bedbug, adult, May 12

Williams, C. L. Glens Falls. Lygus pratensis Linn., tarnished plant bug, work on dahlia, July 17

Strickland, L. F. Lockport. Poecilocapsus lineatus Fabr., four-lined leaf bug, adults on currant, June 19

Latham, Roy. Orient Point. Benacus griseus Say, giant water bug, adult, June 10

Orthoptera

Dummett, Arthur. Mount Vernon. Diapheromera femorata Say, walking-stick, adult, August 20

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Thysanura

Stagg, J. E. Buffalo. Through State Department of Agriculture. Lepisma domestica Packard, silver fish, adult, October 25

Acarina

Osterhout, G. E. Windsor, Col. Eriophyes pruni Schoene, plum mite, galls on plum, July 22

Herrick, G. W. Ithaca. Phyllocoptes quadripes Shimer, bladder maple gall, galls on soft maple, June 11

Babcock, H. N. Elmira. Same as preceding, June 24

ZOOLOGY

Donation

Mammals

Paine, Silas H. Silver Bay
Red squirrel, Sciurus hudsonicus (Erxleben)..... 3

Birds

Rensselaer Polytechnic Institute, Troy
Dowitcher, Macrorhamphus griseus (Gmelin) 1
Hudsonian godwit, Limosa haemastica (Linnaeus) 1
Sharp-shinned hawk, Accipiter velox (Wilson).... 1
Pigeon hawk, Falco columbarius (Linnaeus).. 1
Ivory-billed woodpecker, Campephilus principalis (Linnaeus) 1
Prairie hen, Tympanuchus americanus (Reich.). 1

Sanford, Dr Leonard S. New Haven, Conn.
Old squaw, Harelda hyemalis..... 1

Birds' nests

Delavan, Dr C. H. Round Lake
Baltimore oriole, Icterus galbula (Linnaeus)..... 1
Red-eyed vireo, Vireosylva olivacea (Linnaeus). 1

Fishes

Bean, Dr Tarleton H. Albany
Dace, Semotilus bullaris (Rafinesque)..... 1

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Invertebrates

Casselman, E. S. Lake Delaware

Copepods, Cyclops strenuus Fischer..... 1 lot

Peck, H. S. Menands

Spider, Lycosa carolinensis, Walckenaer, female and eggs..... 1

Cass, Allan. Albany

Slug, Limax maximus, Linnaeus..... 1

Bean, Dr Tarleton H. Albany

Fresh-water clams, Unionidae..... 2 lots

Exchange

Fresh-water and land shells

Baker, H. B. Ann Arbor, Mich.

Goniobasis livescens (Merke)
Campeloma decisum (Say)
Valvata sincera (Say)
Amnicola limosa (Say)
Vitrea ferrea (Morse)
Cochlicopa lubrica (Müller)
Strobilops virgo (Pilsbry)
Succinea retusa (Lea)
Lymnaea emarginata (Say)
Lymnaea emarginata angulata (Sowerby)
Lymnaea stagnalis appressa (Say)
Lymnaea stagnalis perampla (Walker)
Physa ancillaria magnalacustris (Walker)
Physa ancillaria parkeri (Currier)
Aplexa hypnorum (Linnaeus)
Planorbis hirsutus (Gould)
Planorbis bicarinatus portagensis (Baker)
Planorbis campanulatus smithii (Baker)
Planorbis bicarinatus (Say)
Segmentina crassilabris (Walker)
Sphaerium sulcatum (Lamarck)
Sphaerium acuminatum (Prime)
Pisidium abditum (Haldeman)
Pisidium abditum subrotundum (Sterki)
Pisidium regulare (Prime)
Lampsilis luteola (Lamarck)
Lampsilis nasuta (Say)

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Anodonta grandis footiana (Lea)
Anodontoides ferussaciana subcylindricacea (Lea)

Purchase

Mammals

Barker, Fred. Parker's Prairie, Minn.
Weasel, Mustela cicognani Bonaparte..... 1
Mole, Scalopus aquaticus (Linnaeus)..... 1
Ward's Natural Science Establishment, Rochester
Common dolphin, Delphinus delphis Linnaeus, cast 1

Birds

Barker, Fred. Parker's Prairie, Minn.
Holboell grebe, Colymbus holboelli (Reinhardt).. 1
Ring-billed gull, Larus delawarensis Ord..... 2
Bonaparte gull, Larus philadelphia (Ord)..... 1
Common tern, Sterna hirundo Linnaeus..... 3
Black tern, Hydrochelidon nigra surinamensis (Gmelin) 2
White pelican, Pelecanus erythrorhynchos Gmelin 1
Virginia rail, Rallus virginianus Linnaeus..... 2
Stilt sandpiper, Micropalma himantopus (Bonaparte) 1
Semipalmated sandpiper, Ereunetes pusillus (Linnaeus) 2
Lesser yellowlegs, Totanus flavipes (Gmelin)..... 2
Black-breasted plover, Squatarola squatarola (Linnaeus) 3
Killdeer plover, Oxyechus vociferus (Linnaeus). 2
Ring-necked plover, Aegialitis semipalmata (Bonaparte) 2
Brown, Wilbur. Albany.
Barred owl, Strix varia Barton..... 1
Danygriz, Mathew. Albany
Sora, Porzana carolina (Linnaeus)..... 1
Yellow rail, Coturnicops noveboracensis (Gmelin) 1
Wilson phalarope, Steganopus tricolor (Vieillot). 1

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Avocet, Recurvirostra americana Gmelin..... 1
Stilt sandpiper, Micropalma himantopus (Bonaparte) 1
Least sandpiper, Pisobia minutilla (Vieillot)..... 1
Marbled godwit, Limosa fedoa (Linnaeus)..... 1
Willet, Catoptrophorus semipalmatus (Gmelin) 1
Upland plover, Bartramia longicauda (Bechstein) 1
Buff-breasted sandpiper, Tryngites subruficollis (Vieillot) 1
Spotted sandpiper, Actitis macularius (Linnaeus) 2
Long-billed curlew, Numenius americanus Bechstein 1
Golden plover, Charadrius dominicus Müller.... 4
Turnstone, Arenaria interpres (Linnaeus)..... 1
Rough-legged hawk, Archibuteo lagopus sancti-johannis (Gmelin)..... 1
Great horned owl, Bubo virginianus (Gmelin).. 1
Pileated woodpecker, Phloeotomus pileatus (Linnaeus) 2
Redpoll linnet, Acanthis linaria (Linnaeus)..... 2
White-crowned sparrow, Zonotrichia leucophrys (Forster) 1

Sanderson, W. Rensselaer
American scoter, Oidemia americana (Swainson and Richardson) 2

Birds' nests and eggs

Hart, C. G. East Berlin, Conn.
Red-shouldered hawk, Buteo lineatus (Gmelin), nest and three eggs.
Cooper hawk, Accipiter cooperi (Bonaparte), nest and four eggs.

Reptiles

Ward's Natural Science Establishment, Rochester
Harp turtle, Dermochelys coriacea (Vandelli) cast 1

Amphibia

Ward's Natural Science Establishment, Rochester
Common tree toad, Hyla versicolor Le Conte, casts. 3

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ARCHEOLOGY

Donation

Auringer Collection, donated by Dr Albert Vander Veer

Quartz spear	1
Arrow points, stone	180
Stone hoes	6
Spears	28
Hammers	30
Cache of flints	40
Pestles, roller	6
Metates	4
Slate knives, Esquimeaux	4
Steel lance head	1
Beads, 1 string	1
Pitted stones	20
New sinkers	102
Worked stones	184
Notched axes	12
Celts	54
Pottery fragments	52
Pot stone, worked fragments	21

Bird, Daniel. Troy

Skull and fragments of skeleton	1

Burmaster, E. R. Irving

Mound skull	1
Pottery fragments	4
Stone celt	1
Crude celt	1
Hammer stones	1

Holden, Hon. J. A. Glens Falls

Cylindrical pestle	1

Hurd, A. S. Troy

Specimen fine semilunar knife	1
Specimen scraper	1
Fragments pottery	10

Purchase

Tann, Mrs Charles. Troy

Triangular flints	16
Arrow points	71
Spears	16
Leaden effigy of tomahawk	1

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Kopple, Pauline. New York
Carved wooden crucifix..... 1
Schmits
Baskets..... 3
Nicholson, A. S. Neopit, Wis.
Bark house..... 1
Bradly, E. R. Cazenovia
Grooved shaft stone..... 1

Collection in the field

Parker, A. C.
Algonquin bark hamper..... 1
Brass medal..... 1
Wooden spoons..... 2
Seneca mask..... 1
Stone hatchet..... 1

THE MOUNT MORRIS METEORITE

BY H. P. WHITLOCK

The State Museum has recently acquired by purchase a meteoric fragment which represents a hitherto unrecorded fall, and adds another occurrence to the small number of authenticated meteorites from New York State.

The specimen was found in December 1897 by Mr Frederick H. Crofoot, on the Landers farm about one and one-half miles south of Mount Morris, Livingston county, N. Y. It measures 30 mm x 20 mm x 13 mm and weighs 12.48 grams. The shape roughly suggests a rhomboidal solid similar to a distorted rhombic-dodecahedron, although this rough shape has in all probability no significance and is purely accidental. One side has been roughly polished, showing the structure.

The structure classification which was determined as nearly as possible macroscopically, places this meteorite in the group Chondrites, the ground mass being composed of spherulitic chondrules of enstatite and olivine of irregular sizes. The ground mass is broken by irregular shotlike grains of iron.

Notwithstanding the small size of the specimen, all the evidence appears to confirm the statement of Mr Crofoot that the present fragment represents the entire bulk of this fall.

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Figure 1 gives a full-size view of the meteorite, showing the general shape and character of the surface. Figure 2 shows the polished surface of one side; the brilliantly reflecting portions of the surface are the iron particles included in the ground mass.



Fig. 1 Full-size view showing general shape and character of the surface

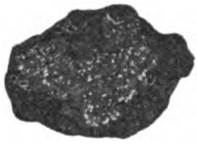


Fig. 2 Full-size view showing polished surface of one side

The following list gives the authenticated meteorites which have been found in New York State.

LOCALITY OF FALL	REPRESENTED IN N. Y. STATE MUS. COLL.	DATE OF DISCOVERY	PUBLISHED ACCOUNT	AUTHOR
Bethlehem, Albany co	×	aAug. 11, 1859	Am. Jour. Sci. (2). *28*:300.	C. V. Shepard
Burlington, Otsego co	×	Previous to 1819	Am. Jour. Sci. (1). *46*:401	James Pierce
Long Creek, Jefferson co	.....	.....	In British Museum Coll	.....
Lockport, Niagara co	.....	1818	Am. Jour. Sci. (1). *48*:388.	B. Silliman
Mount Morris, Livingston co	×	1897	.....	.....
Scriba, Oswego co	×	.....	Am. Jour. Sci. (1). *40*:336.	C. V. Shepard
Seneca Falls, Seneca co	.....	.....	Am. Jour. Sci. (2). *2*:39.	C. V. Shepard
Seneca River, Cayuga co	.....	.....	Am. Jour. Sci. (2). *14*:439.	E. W. Root
Tomhannock, Rensselaer co	×	.....	Am. Jour. Sci. (3). *34*:60.	Bailey
Yorktown, Westchester co	.....	.....	.....	.....

a Observed fall.

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EARLY PALEOZOIC PHYSIOGRAPHY OF THE SOUTHERN ADIRONDACKS

BY WILLIAM J. MILLER

INTRODUCTION

For many years the problem of the early Paleozoic physiography of the Adirondack region has been an important one to all interested in the geological history of northern New York. Observations made during the past ten or fifteen years have thrown much light upon this problem, especially significant being the work of Cushing, Kemp, Ruedemann, and Ulrich. For some years the writer also has been studying the geology of the southern Adirondacks, the five quadrangles which he has mapped in detail all having important bearings upon the subject. It is the purpose of this paper to bring together old and new observations in an attempt to reconstruct the major physiographic features of the southern Adirondack region during the Cambric and Ordovicic periods. The Black river, Mohawk and Champlain valleys will be discussed only in so far as facts from those regions have a direct bearing upon the problem. Since the Paleozoic rock outliers in the southeastern Adirondacks are particularly significant in this connection, they will be duly emphasized.

Some of the principal questions discussed are the following:

1 What was the character of the surface of the Precambric rock upon which the early Paleozoic sea encroached?

2 Were the early Paleozoic sediments deposited in embayments of the sea extending into the Precambric rock area or did they form a more general mantle over the Precambric rocks?

3 Was the southern Adirondack region ever completely submerged during the Paleozoic era and, if so, when?

4 Where were the principal land areas located during the Cambric and Ordovicic periods?

5 Does the present northeast-southwest main axis of elevation through the Adirondacks also have an early Paleozoic significance?

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CAMBRIC PHYSIOGRAPHY

The Cambric peneplain. As is well known, the whole Adirondack region was above water and undergoing erosion during the early and middle Cambric. This is proved by the total absence of the early and middle Cambric strata and also because there is not the slightest evidence that any such strata ever were deposited over the region. Furthermore there is every reason to believe that this important erosion interval was inaugurated long before the opening of the Paleozoic era. As a result of this vast erosion the whole Adirondack region had, by the opening of Potsdam (late Cambric) time, become worn down to the condition of a more or less well-developed peneplain.

As will be shown below, the distribution of the strata proves that the northeastern and eastern borders of the Adirondacks sank below sea level first in early Potsdam time; then the southeastern and southern portions in late Potsdam, Theresa and Little Falls times; and last the southwestern border well along in Ordovicic (Pamelia) time.

The peneplain surface of the Precambric rock under the Paleozoic strata has been carefully studied on all sides of the Adirondacks and it has been fully demonstrated that it is roughest along the northeastern and eastern sides; less rough along the southeastern and southern sides; and very smooth along the southwestern side. Even where roughest the differences of elevation never amount to more than a few hundred feet, while on the southern side Cushing[2] and the writer[10] have each found knobs or ridges of hard Precambric rock projecting upward from fifty to eighty feet into the Cambric strata, though these appear to be extreme cases of ruggedness of the surface of the peneplain. Along the southwestern border of the Adirondacks the writer has shown by his mapping of the Port Leyden quadrangle[9] that the surface of the peneplain is there remarkably smooth. This increasing smoothness of the peneplain from northeast to southwest is precisely what would be expected because the southwestern side of the Adirondacks remained dry land much the longest time. In the eastern Adirondacks Kemp[6]

[2] Page 57–58. The footnote numbers refer to the numbered references given in the list at the end of this paper.

[10] Page 51.

[9] Pages 40–41.

[6] Pages 408–12.

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has argued that the major relief features immediately prior to the advent of the Potsdam sea were valleys carved out along the belts of weaker Grenville strata, especially the limestones.

Positive evidence regarding the physiographic condition of the interior Adirondack region during Cambric time is of course lacking, but there is no reason whatever for thinking that it was essentially different from the immediately surrounding regions except probably that the general altitude was somewhat greater.

Encroachment of the late Cambric sea. Cushing[3] has proved that the Potsdam sea encroachd upon the Adirondack region from the northeast toward the southwest because the sandstone formation of that age progressively thins from a thickness of over one thousand feet to disappearance in the southwest. During the encroachment of this late Cambric sea, did the waters enter distinct embayments or estuaries as Kemp[6] has suggested or did they form a more regular shore line? Along the eastern side, where the topography was moderately rugged, such embayments were quite likely physiographic features of some importance due to a drowning of the valleys which had been cut out along the belts of weaker Grenville strata. In the southern Adirondacks, however, the evidence is decidedly against the encroachment of the late Cambric sea by setting up anything like well-defined embayments or estuaries extending into the area of Precambric rock.

The outliers of Palezoic rock in the southeastern Adirondacks are of first importance in this connection. All the definitely known outliers well within the Precambric rock area of this region are given in the following list:

1 A small exposure of Potsdam sandstone near the southwestern corner of the Elizabethtown quadrangle and near the village of North Hudson.

2, 3, 4 Three outliers of Potsdam sandstone along the eastern side of the Paradox Lake quadrangle.

5 The Little Falls dolomite outlier (probably with underlying Potsdam) at Schroon Lake village, Schroon Lake quadrangle.

6 A small outlier of Potsdam sandstone one and one-half miles west of the village of North River in the northeastern corner of the Thirteenth Lake quadrangle.

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[3] Pages 279–80.
[6] Pages 408–12.

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7 A small outcrop of Theresa sandstone and dolomite (probably with underlying Potsdam) near the northern border of the Luzerne quadrangle and one mile due west of High Street village.

8 The outlier in the Sacandaga valley at Wells, Lake Pleasant quadrangle. This, the largest and most interesting of all the outliers, shows Potsdam sandstone, Theresa transition beds, Little Falls dolomite, Black River (Lowville) limestone, Trenton limestone, and Canajoharie (Trenton) shale.

9 An outlier showing Theresa beds, Little Falls dolomite, and Black River limestone in the Sacandaga river valley of the Lake Pleasant quadrangle and between one and three miles northwest of Hope postoffice.

Of these, numbers 7 and 9 have been discovered by the writer within the past three years.

Besides the above there are a number of other outliers close to the main body of Paleozoic strata as: In the valley one and one-half miles west of Northville (Broadalbin quadrangle) and including Potsdam, Theresa and Little Falls strata; several Potsdam sandstone outliers within the tongue of Precambric rock lying just east of Lake George; and several others in the northwestern portion of the Ticonderoga quadrangle.

Wherever detailed geologic maps have been recently made in the southeastern Adirondacks the region is shown to be literally cut to pieces by numerous normal faults, as many as fifteen to thirty being clearly recognizable within single quadrangles. Most of the prominent faults strike northeast-southwest with throws usually ranging from a few hundred to two thousand or more feet. It is important to note that all the outliers above mentioned as occurring well within the Precambric rock area, except possibly those of the Paradox Lake quadrangle, lie on the downthrow sides of such faults. In the case of the Wells outlier (No. 8) the valley is of the nature of a "graben" or fault-trough with a prominent fault on each side so that the block of Paleozoic rock has been dropped down no less than sixteen hundred feet to its present position. Thus there appears to be no escape from the conclusion that the valleys containing these outliers have been largely produced by faulting and that the Paleozoic strata formerly lay at a much higher level, that is, the general level of the Precambric rock surface.

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It should be pointed out that the possible exceptions in the cases of the outliers along the eastern side of the Paradox Lake quadrangle, as well as those of the Ticonderoga quadrangle and to the east of Lake George, all lie close to the general Paleozoic rock area and in that portion of the southern Adirondacks upon which the late Cambric sea first encroached and where the topography was most rugged so that it is quite possible that local embayments receiving Cambric sediments did there exist.

In the cases of all the other and important outliers there does not appear to be any direct evidence favoring the existence of embayments nor any need for such an explanation to account for the phenomena of the outliers. Simple downfaulting of the Paleozoic strata has often carried masses of these so far down that remnants have been protected from complete removal by subsequent erosion. As already shown the southern Adirondack region was, by the beginning of the Potsdam, worn down to a peneplain upon whose surface only a few very minor irregularities existed. This being the case, anything like prominent embayments or estuaries could not possibly have existed. Another argument decidedly against the embayment idea comes out of the character of the sediments within the outliers. Thus the dolomite in the Schroon Lake and Wells outliers is a distinctly marine formation of exactly the same character as that of the general Paleozoic rock area. Or again, the Canajoharie black shale at Wells is both faunally and lithologically distinctly marine and precisely like that of the Mohawk valley. Estuarine deposits would show certain distinct local variations and hence the very uniformity of sediments in the outliers precludes the possibility of deposition in estuaries. Thus we are forced to conclude that when the early Paleozoic sea encroached upon the southern Adirondacks, the shore line was fairly regular, with possibly some very small local embayments along the eastern side, and that a general mantle of sediments was deposited over the whole southeastern Adirondack region.

Extent of the Cambric seas. Nearly all the Paleozoic outliers show the presence of Potsdam sandstone, and in the few cases where it does not actually outcrop it is most likely present though concealed from view. In the southern Adirondacks no Potsdam sandstone outcrops west of a nearly straight northeast-southwest line passing through the outliers at or near North Hudson (No. 1), North River (No. 6), Wells (No. 8), and

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through the village of St Johnsville in the Mohawk valley. Thus we are certain that the shallow Potsdam sea overspread practically the whole southern Adirondack region east of this line except for a few local knobs or ridges of hard Precambric rock which remained above the sea level. A fine example of such a local projection above the Potsdam sea level has been described by the writer[10] in his report on the Broadalbin quadrangle. That the Potsdam shore line extended a short but unknown distance farther west than Wells and North River is certain because a considerable thickness of sandstone is still represented at those places. This conclusion regarding the position of the Potsdam shore line is in harmony with the statement of Ulrich and Cushing[16] when they say: "It is thought that along the Mohawk line the Potsdam shore had a southwesterly trend more to the south than the present Precambric margin, the two meeting at an angle; east of the meeting point the Potsdam appears under the Little Falls, while west of it the Potsdam is either absent or erosion has not yet cut down to it."

That the southwestern Adirondacks were not submerged under the Potsdam sea is proved by the complete absence of the sandstone from the southwestern border; the very character of the sediments (sands and pebbles) which demands nearness to a mass of Precambric rock; and the negative evidence from the fact that no outliers of Potsdam have ever been found in this region. The Potsdam sea did extend up the St Lawrence valley as shown by the presence of the sandstone there.

Thus we conclude that a long, low, land area of Precambric rock extended in a northeast-southwest direction through the Adirondack region, and that this height of land in Potsdam time had almost exactly the same position as the present main axis of elevation of the mountains.

Since the Potsdam sandstone grades into the succeeding, alternating sandstone and dolomite beds of the Theresa and the two formations have almost precisely the same distribution, we are safe in asserting that the physical geography conditions of Theresa time were essentially like those of Potsdam time except that the southeastern Adirondacks were then even a little more submerged.

The distribution of the Little Falls dolomite which succeeds the Theresa beds without unconformity along the southern and

[10] Pages 51–52.
[16] Page 139.

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southeastern border of the Adirondacks and in the outliers at Schroon Lake and Wells shows that the Little Falls sea extended over at least as much of the southern Adirondacks as did the Potsdam-Theresa seas. In the Mohawk valley region it extended considerably farther westward overlapping upon the Precambric rock to the southwest corner of the Wilmurt quadrangle where the dolomite thins out to disappearance. From this point northwestward the Precambric rock margin shows no dolomite, thus proving the absence of the Little Falls sea there. The very rapid decrease in thickness of the dolomite from four hundred feet at Little Falls to complete disappearance just beyond the northern boundary of the Little Falls quadrangle also shows the limit of the sea in that district. Accordingly there must have been a large land mass in the southwestern Adirondack region. The very presence of so many sand grains in the dolomite (giving rise to the old name Calciferous sandrock) requires that it was deposited comparatively near a land mass. Thus during late Little Falls time the eastern portion of the southern Adirondacks was submerged while the western portion remained dry land, the shore line extending from the southwest corner of the Wilmurt quadrangle most probably in a northeasterly direction through the southern Adirondacks. That its shore line was, in general, a little farther westward than that of the Potsdam sea is strongly suggested by the fact that all the Cambric sediments were gradually accumulated in a downsinking trough occupying the southeastern Adirondack area. This idea of a gradual westerly encroachment of the Cambric sea is borne out by the following facts: The thickness of the Cambric section within the Saratoga quadrangle is from four hundred to five hundred feet; within the Broadalbin quadrangle near Northville four hundred to four hundred and fifty feet; and at Wells about two hundred feet. This rapid decrease in thickness of two hundred feet from Northville to Wells within a distance of fourteen miles shows a westward to northwestward encroachment of the Cambric sea and that the downward slope of the surface here receiving Cambric sediments was fourteen feet a mile toward the southeast.

According to Ulrich and Cushing[16] there is a distinct stratigraphic break represented by a notable erosion unconformity at the top of the Little Falls dolomite. Thus all available evidence supports the idea that, by the close of the Cambric period, subsidence

[16] Page 129.

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ceased and the whole southern Adirondack region was raised above sea level and underwent erosion. The western portion of this land area was of Precambric rock while the surface rock in the eastern portion was Little Falls dolomite.

To summarize for the Cambric period: All evidence is decidedly against a complete submergence of the southern Adirondack region during the late Cambric period, the land mass of the time having occupied at least all of Hamilton county except its southeastern portion; all the northern half of Herkimer county; and most of the eastern portion of Lewis county. This axis of elevation most likely continued northeastwardly through the Adirondack region to its northeastern portion and occupied about the same area as the present main axis of elevation of the mountains. The close of the Cambric witnessed an uplift sufficient to convert the whole southern Adirondack region into dry land.

ORDOVICIC PHYSIOGRAPHY

Early Ordovicic. According to Ulrich and Cushing[16] the Tribes Hill limestone is the earliest Ordovicic formation. Its distribution demonstrates that the Mohawk valley to a little northwest of Little Falls and the lower Black river valley were submerged. Its total absence from the southwestern Precambric boundary, from the outlier at Wells, and from the vicinity of Northville and Saratoga Springs strongly suggests that little if any of the southern Adirondack region was submerged under the Tribes Hill sea. This limestone is probably not present in the Champlain valley but, if it is, a little of the eastern border of the Adirondacks may have been submerged. It would seem, therefore, that this Tribes Hill submergence was not as extensive as that of Little Falls time. After the deposition of the Tribes Hill limestone, however, there was a long erosion interval continuing to Black River time and hence because of removal of Tribes Hill limestone by this erosion it is more than likely that the present outcrops do not indicate the full extent of the Tribes Hill sea. At any rate there is not the slightest direct evidence for any considerable submergence of the southern Adirondack area at this time.

During the long interval between Tribes Hill and Black River times the whole southern Adirondack region was above sea level except locally along the western border for a short time when

[16] Pages 128–30.

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the Pamelia (Chazy) limestone was being deposited in the Black river valley and also locally along the eastern border when certain other limestones of the Chazy group were being laid down in the Champlain trough.

For most part the various Black River limestone members are thin and patchy in their distribution except in the Black river valley, and no attempt is here made to enter into the details of physiography and oscillations of level in Black River time. Suffice it to say that early Black River (Lowville) limestone is present on all sides of the southern Adirondacks and in the outlier at Wells, it being but a few feet thick in the eastern and southern portions and fifty to sixty feet thick along the western border. Therefore, judging by the areal distribution and thinness of the Lowville we are practically certain that the central western portion of the Adirondack area was not submerged during early Black River time. Thin limestone deposits of late Black River age are confined to the vicinity of Watertown (Watertown limestone) and along the eastern and southeastern borders of the Adirondacks (Amsterdam limestone) with deposition in these two regions not occurring simultaneously. Thus there could not have been anything like extensive submergence of the southern Adirondacks in late Black River time.

The widespread unconformity at the summit of the Black River group of limestones shows that a general upward oscillation occurred and that the whole southern Adirondack region became dry land before the succeeding Trenton submergence.

Late Ordovicic. During Trenton time there was a widespread submergence of much of the southern Adirondack region as shown by the existence of Trenton limestone or shale hundreds of feet thick on all sides of the region and even in the outlier at Wells. The limestone is almost wholly confined to the western side, there being but a few feet of limestone at the base of the Trenton on the eastern side where thick shales (Canajoharie and Schenectady) comprise nearly the whole section.

Considering the thickness (about four hundred feet) of the Trenton limestone in the upper Black River valley and the slope of the surface[9] on which deposition occurred, the Trenton sea could not have extended more than forty miles eastward into the Adirondack area. If we consider deposition to have taken place in a distinctly downwarped trough, then the Trenton sea must have extended in

[9] Page 43.

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considerably less than forty miles, and this is the most likely view. By a similar line of reasoning Cushing[2] has shown that the Trenton sea could not have reached more than ten miles north of the north boundary of the Little Falls quadrangle. The thickness of about three hundred feet of Trenton (mostly shale) in the outlier at Wells shows that the Trenton sea must have reached at least a few miles north and west of that locality. Pebbles of Precambric rock and grains of sand in the Trenton limestone at Wells, however, make the existence of near-by land (Precambric rock) practically a certainty as argued by Kemp.[7]

From the above statements we conclude that dry land existed in the region of southwestern Hamilton county and also most probably over all of northern Hamilton county. It is worthy of note that this Trenton land mass, with northeast-southwest trend, occupied the same region as the present belt of highest land in the southern Adirondacks, and also that this land mass, though now smaller, occupied the same position as that of late Cambric and early Ordovicic times. The absence of Paleozoic rock outliers west of a northeast-southwest line through Wells and North River at least affords interesting negative evidence in harmony with this view.

Regarding Utica and Postutica times the results of recent work are decidedly against submergence of the whole Adirondack region. Considering the great thickness of Paleozoic strata; the slope of the surface of the Precambric rock; and the existing altitudes within the Adirondacks, Walcott, Cushing and the writer have all been led to conclude that the late Ordovicic sea must have extended almost, if not quite, across the whole Adirondack area. Many years ago Walcott[17] said: "There was a practically conformable deposit of sediments against and over the area of the Adirondack mountains from early Cambric times to the close of the deposition of the Utica shales, except in the case of the unconformity by non-deposition between the Potsdam and the Chazy."

Later Cushing,[1] as a result of his studies along the northeastern border of the Adirondacks, said: "The basal Potsdam is found running up to an elevation of seventeen hundred fifty feet in the northern Adirondacks. With the relief of the region as it is now the deposition of the minimum thickness (four thousand feet) of

[1] Page 77.
[2] Page 61.
[7] Page 152.
[17] Pages 24–25.

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the Paleozoic rocks assigned above on this Potsdam would leave none of the present peaks projecting above the general level." Again he stated:[3] "This submergence (Utica) apparently completely overswept the old Adirondack island, and that for the first time in its paleozoic history, with the possible exception of the latter part of the Trenton."

Still later the writer,[9] speaking of the Paleozoic sediments along the southwestern border of the Adirondacks, said: "This thickness (fourteen hundred feet) is great enough so that even after allowing for decreased thickness due to overlap and a possibly increased slope (receiving sediments) as the heart of the Adirondacks was approached, we seem to have here a strong argument in favor of the submergence of the region for many miles to the east and northeast of Port Leyden, so that by the close of the Lower Siluric (Ordovicic) the submergence extended to, or close to, the heart of the Adirondacks."

This line of reasoning, however, does not regard the possible importance of downwarping troughs of deposition. As already shown in this paper, such troughs of deposition clearly did exist from Potsdam through Trenton time and we have no good reason to doubt their existence during Utica and late Ordovicic time as well. In a recent paper Cushing[4] says: "As the evidence accumulates it points more and more strongly to deposit in downwarping troughs, in which large depth of deposit by no means implies extensive overlap on the shores. . . . Even when submerged at the same time, as in the Trenton, the deposits on the two sides (east and west) are so different both lithologically and faunally, as to indicate that the two basins had no very direct connection."

Some years ago Ruedemann,[14] by noting the parallel positions of the graptolites in the black shales at Wells, Dolgeville (Herkimer county), along Nine Mile creek near Trenton Falls (Oneida county), etc., proved the existence of a late Ordovicic ocean current across the southern side of the Adirondack region. The proof for the existence of such an ocean current by no means implies that it swept entirely across the whole Adirondack region, and hence we have here no argument for a complete submergence of the region at that time. In fact Ruedemann gives good reason for the belief

[3] Page 285.
[4] Page 144.
[9] Page 43.
[14] Pages 367–91 and [15] Pages 75–81.

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that this current which was a southerly to southwesterly one along the eastern side of the Adirondack region changed to a more westerly current along the southern side, and this is precisely what would be expected in the case of a current sweeping partly around a land mass occupying the central Adirondack area.

Further, the very recent work of Ruedemann shows that the shales of the lower Mohawk valley and Champlain valley which have always been regarded as of Utica age are, in reality, of Trenton (Canajoharie and Schenectady) age; that the Utica shale is wholly absent from those regions; and that there is no evidence of their ever having been deposited there. Hence any argument for the complete submergence of the Adirondacks during Utica time receives a serious setback.

In the Black River valley the Utica is followed without interruption by the Frankfort and Pulaski shales and sandstones. The combined thickness (about nine hundred feet) there of the Utica, Frankfort, and Pulaski clearly implies, even considering deposition in a downwarping trough, that the sea spread well over the western side of the southern Adirondack region. However, the very character of the Frankfort and Pulaski rocks, which contain so much sandstone, implies comparative nearness to land undergoing pretty rapid wear and more than likely this land mass, in part at least, lay in the same general region as that of earlier time. In the vicinity of Utica the Pulaski beds are missing, signifying dry land there during that time, while on the southern and eastern sides the only strata of Posttrenton age are the Indian Ladder beds of Albany county which are thought to correlate with the Frankfort beds and which signify local subsidence at that time for that region. The outlier at Wells furnishes no data for Posttrenton time because of the absence of any strata younger than Canajoharie age.

South of Utica there is an important stratigraphic break between the Oneida (Siluric) conglomerate and the underlying Frankfort (Ordovicic) shales. This unconformity is very distinct so that prior to the deposition of the Oneida the region around Utica was well above sea level and undergoing erosion. The only possible source of the pebbles in the Oneida formation would seem to have been an area of Precambric rock, more than likely situated in that same portion of the Adirondacks which never became submerged during the Cambro-Ordovicic periods. That this uplift, which began in the late Ordovicic, affected the region as far eastward as the Hudson valley, and that the land remained above sea level for a long time

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is shown by the complete absence of the Oneida conglomerate and the nearly complete absence of the Clinton and Niagara formations from southern Herkimer county eastward. Such a widespread and important elevation of the land in the Mohawk valley region almost certainly upraised the whole southern Adirondacks except possibly the very western border. Cushing[3] has given evidence to show that the northeastern Adirondack area was distinctly elevated even earlier in the late Ordovicic than the southern area. It is more than probable that this period of elevation in northern New York culminated with the great Taconic revolution.

To summarize for Ordovicic Posttrenton time we find that a considerable portion of the western side of the Adirondacks was submerged, while the whole middle and eastern portion was dry land except possibly locally along the southeastern border during the deposition of the Indian Ladder beds. After the deposition of the Frankfort shales there was an important uplift (inaugurating the Taconic revolution) which brought the whole southern Adirondack area, except probably the very western border, well above sea level, and we have no good reason to think that any considerable portion of the Adirondack region was ever again submerged.

Some of the more important conclusions, regarding the early Paleozoic physiography of the southern Adirondacks, reached in this paper are the following:

1 The early Paleozoic sea encroached upon a more or less well-developed peneplain in the Adirondack region, this peneplain being moderately rugged in the northeastern and eastern portions; less so in the southern portion; and very smooth in the southwestern portion, such a difference in character of the peneplain no doubt being due to the fact that the southwestern portion longest remained above sea level.

2 When the early Paleozoic sea encroached upon the region it did not set up embayments or estuaries in the Precambric rock area, except possibly to some extent on the eastern side, as shown by the peneplain character of the Precambric rock surface; the typical marine character of the deposits in the Paleozoic rock outliers; and the downfaulted structure of the outliers.

3 The region was never completely submerged during the Paleozoic era though, at the time of maximum submergence during the Trenton, only a comparatively small land mass remained.

[3] Page 285.

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4 The land areas varied considerably in extent from time to time, but the principal area of unsubmerged Precambric rock ran in a northeast-southwest direction through the southern Adirondack region and most likely continued through the northern region.

5 This prominent northeast-southwest structural belt or axis of elevation, occupying practically the same position as the present main axis of elevation of the mountains, has played an important part in the geological history of northern New York.

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THE GARNET DEPOSITS OF WARREN COUNTY, NEW YORK

BY WILLIAM J. MILLER

INTRODUCTION

The principal garnet mines of the United States are located in Warren and Essex counties of the eastern Adirondacks, those of Warren county — especially the Hooper and Rogers mines below described — being the greatest producers. All the Warren county mines are in its northwestern portion and within six or eight miles of North Creek village which is at the terminus of the Adirondack branch of the Delaware and Hudson Railroad.

GENERAL GEOLOGIC FEATURES

The garnet mines of Warren county lie wholly within the precambrian rock area of the Adirondacks. The oldest rocks in the garnet region are the highly metamorphosed sediments of the Grenville series. Detailed mapping by the writer has shown extensive areas of Grenville which are unusually rich in limestone and closely associated hornblende gneiss.

Next in age come plutonic igneous rocks such as syenite, granite, and granite porphyry which are clearly intrusions into the Grenville and all of which are differentiation products from the same great cooling magma. Of these rocks the syenite is, perhaps, the most abundant. It is a medium to fairly coarse grained, generally quartzose and hornblendic rock with sometimes a more basic variety carrying a green pyroxene. The granite is highly quartzose and always contains hornblende or biotite or both. The granite porphyry is biotitic to sometimes hornblendic with large, pink, feldspar crystals imbedded in a fine to medium grained matrix. All these rocks are distinctly gneissoid.

As a result of the great intrusion, the Grenville in some cases appears to have been pushed upward and to have been largely removed by erosion since; in other cases the Grenville was more or less engulfed by, or involved with, the molten flood as shown by the numerous inclusions and the areas of mixed gneisses; while in still other cases the Grenville rocks were left practically intact as shown by the large areas of pure Grenville.

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Minor intrusives, cutting all the above masses, occur as bosses or dikes of gabbro, pegmatite, or diabase.

An important structural feature is the presence of numerous normal faults which have greatly dissected the region.

DESCRIPTION OF THE GARNET DEPOSITS

There are at least seven localities in Warren county where garnet mining has been carried on as follows: (1) Rogers (Barton) mine[1] near the top of Gore mountain and three and one-half miles west-southwest of North Creek; (2) near the top of Oven mountain and four miles south of North Creek; (3) the Rexford mine, one and one-third miles a little east of south of North Creek; (4) the Parker mine just southwest of Daggett pond and four and one-half miles northwest of Warrensburg; (5) the Sanders Brothers mine near the mouth of Mill Creek and two miles east of Wevertown; (6) two and three-fourths miles north of North Creek; and (7) the Hooper mine just east of the northern portion of Thirteenth lake. Of these, only the Rogers, Sanders Brothers, and Hooper mines are now in operation. The Rogers and Hooper mines lie within the Thirteenth Lake quadrangle and the others within the North Creek quadrangle. All the above mines have been visited by the writer.

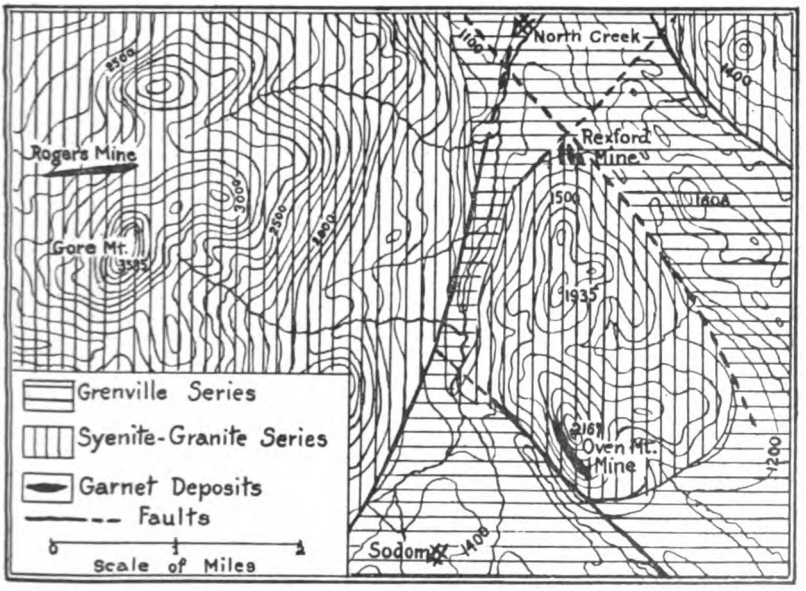
1 In the Rogers mine the mode of occurrence and the size of the garnets are of unusual interest. The matrix or rock carrying the garnets is a gray, medium grained gneiss which, in thin section, shows: 20 per cent orthoclase; 20 per cent labradorite; 40 per cent hornblende; 15 per cent hypersthene; 3 per cent biotite; together with a little magnetite and zoisite. Imbedded in this gray matrix are numerous, well-scattered, translucent, reddish-brown garnets, those with diameters up to five or six inches being very common, while the largest ones taken out are said to have been about the size of a bushel basket. These garnets, which are of the almandite variety, are always pretty badly crushed or coarsely granulated and they never show crystal outlines.

A remarkable feature is the never failing occurrence of a rim or envelop of pure, black, medium grained hornblende crystals which completely inclose each garnet. Occasionally a half inch

[1] This is called Moore's mine on the topographic map.

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irregular mass of acid plagioclase or a crystal of biotite may lie between the garnet and the hornblende rim. As a rule the hornblende rims increase in width with the size of the garnets, some rims being as much as two or three inches wide. These reddish-brown garnets, completely surrounded by the black hornblende rims which are, in turn, imbedded in the gray gneiss matrix, present a striking appearance in the walls of the great mine pits.



Geologic and topographic sketch map of portions of the North Creek and Thirteenth Lake (U. S. G. S.) sheets, showing the mode of occurrence of those garnet deposits which are lenslike inclusions in the syenite or granite.

This garnet-bearing rock clearly occurs as a long, narrow, lenslike inclusion of Grenville gneiss in the great mass of Gore mountain syenite. The inclusion is fully three-fourths of a mile long, with nearly east-west strike. Several large openings have been made in it and, in the very large more easterly pit, the width of the inclusion is more than one hundred feet. The garnet rock is removed by blasting and reduced by sledge hammers after which the garnets are picked out by hand.

2 In the Oven mountain mine the mode of occurrence is precisely like that in the Rogers mine. In thin section the matrix

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shows: 20 per cent orthoclase; 25 per cent oligoclase to labradorite; 50 per cent hornblende; 2 per cent biotite; 2 per cent magnetite; together with a little pyrite, zoisite, and apatite. As compared with the similar rock from the Rogers mine the lack of hypersthene is noteworthy. Imbedded in the gray matrix are numerous shattered, reddish-brown garnets (almandite) which range in size up to several inches in diameter. Black hornblende rims are invariably present around the garnets.

This garnet rock is a long, narrow, well-defined inclusion of Grenville gneiss in a granitic facies of the great syenite-granite intrusive body.

This mine has not been worked for about twenty years. After blasting out the garnet-bearing rock and reducing it by sledge hammers, the garnets were picked out by hand.

3 At the Rexford mine the type of occurrence is much like that of Oven mountain, only here there appear to be several smaller inclusions of the garnet-bearing gneiss instead of one, and the country rock is a very gneissoid quartz-syenite. Garnets up to five inches across, always with hornblende rims, were noted. There are several mine openings but none have been worked for about fifteen years.

4 The old mine on the Parker farm occurs in a mixed gneiss area with granitic syenite and Grenville interbedded parallel to the foliation strike. These bands of rock are often twenty to forty feet wide, one of them being made up of a nearly pure, granular, medium grained mass of irregular crystals of reddish-brown garnet and bright green pyroxene (coccolite?). About twenty years ago this band of garnet rock was mined, crushed and put into barrels, there being no attempt to separate the pyroxene from the garnet.

5 At the Sanders Brothers mine the mode of occurence is very similar to that of the Parker mine, the bands of Grenville being, however, somewhat less pronounced and numerous. The rock which is mined is pretty badly granulated and consists mostly of intimately associated reddish-brown garnet and green pyroxene (coccolite?) in small grains, with sometimes a little quartz and feldspar. There are some streaks or patches of nearly pure garnet. Work began in 1907 on the south side of the creek, but now all the mining is confined to the north side. The garnet-pyroxene rock is crushed, put into bags, and shipped to all parts of the world.

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6 Years ago an attempt was made to mine the garnets which occur in the coarse, feldspar, biotite, garnet, Grenville gneiss two and three-fourths miles north of North Creek, but this locality is of no special interest.

7 At the Hooper mine the garnets occur as crystals (dodecahedral) often with good crystal boundaries, up to an inch or a little more in diameter. They are thickly scattered through a medium to moderately coarse grained, dark to light gray, very gneissoid, hornblendic rock which has the composition of a basic syenite or an acidic diorite. It is important to note that these garnets never show the rims of hornblende. In fact the garnets may sometimes be almost surrounded by feldspar. This type of occurrence has not been observed on a large scale at any of the other localities within the county, though a rock almost exactly like it occurs at the Rogers mine as a distinct zone (wall rock) intermediate between the typical garnet-bearing gneiss and the country rock of syenite, where the garnet rock grades perfectly into the syenite. The significance of this fact will be explained below.

The deposit is an extensive one and a very large mine pit has been opened up. After blasting out the rock, it is somewhat reduced by sledge hammers, then taken on cars to the mill where it is crushed. By the use of an ingenious method, involving the use of jigs, the garnet (almandite) is almost perfectly separated from the rest of the crushed rock which is of lower specific gravity than the garnet.

ORIGIN OF THE GARNETS

All modes of occurrence of garnets observed by the writer on the North Creek and Thirteenth Lake sheets are summarized as follows:

1 As crystals or grains in various Grenville rocks, for example, the garnet-pyroxene gneiss; the hornblende-garnet gneiss; biotite-garnet gneisses, etc.

2 As distinct crystals frequently occurring in all types of intrusive rocks — syenite, granite, granite porphyry, and gabbro — except the diabase.

3 As large more or less rounded masses with distinct hornblende rims in the long, lenslike inclusions of Grenville hornblende gneiss in syenite or granite.

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4 As more or less distinct crystals (dodecahedral), without hornblende rims, in a certain special basic syenitelike or acidic dioritelike rock.

In case number 1 (for example, Parker and Sanders Brothers mines) the garnets have, in the usual manner, crystallized out of masses of sediments under conditions of thermal and dynamic metamorphism. These garnets are rarely as much as an inch across and their origin presents no problem of special interest.

In case number 2 the garnets appear mostly to have crystallized out of the original magmas, their formation possibly having been due to some assimilation of granville sediment by the syenite or granite. The facts that these garnets occur so sporadically and that actual examples of local assimilation have been observed in the region strongly favor this view. Since these garnets seldom attain a diameter of an inch and are so scattered, no attempt has ever been made to mine them. Sometimes, as in the gabbros, the garnets have often been produced secondarily, or after the cooling of the magma, because they commonly form reaction rims around other minerals.

Case number 3 (for example, Rogers, Oven mountain, and Rexford mines) is of particular interest because of the very large garnets surrounded by the reaction rims of hornblende.

Kemp and Newland[1] have briefly described a garnet deposit (formerly worked by the Messrs Hooper) just across the line in Essex county less than a mile west of the village of North River and four and one-half miles north of the Rogers mine. As judged by their description the type of occurrence appears to be similar to that in the Rogers, Oven mountain, and Rexford mines, though no mention of the hornblende rims is made. In conclusion they say:

> The origin of this peculiar bed presents an interesting theme. The country rock is probably igneous. Its mineralogy and structure favor this derivation. The garnet rock must be either an altered form of a very impure limestone, or else a very basic igneous rock that was an original sheet or dike. The former supposition appeals more strongly to us.

Later Newland[2] says of the garnet deposits in general that:

> The garnet is usually associated with a basic hornblende rock or amphibolite which forms bands and lenses in the more acid gneiss that constitutes the country rock.

In his brief description of the more recently worked garnet deposit of northern Essex county he speaks of the "amphibolite bands, which have been caught up during the intrusion of the

[1] 17th An. Rep. N. Y. State Geol., 1897, pages 548-49.
[2] N. Y. State Mus. Bul. 102, page 71.

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anorthosite, or have been folded into the latter and metamorphosed."

From these statements we see that three possible modes of origin of these garnet-bearing beds have been suggested, namely that they are: lenses of sedimentary rock actually included in the igneous rock; or sediments folded into the igneous rock and metamorphosed; or sheets or dikes of very basic igneous rock. Now the work of the writer shows that, without question, these garnets occur in lenses of Grenville sediments which were caught up or included in the great igneous masses at the time of their intrusion, the tremendous heat and pressure being especially favorable for a very complete rearrangement and crystallization of the masses (inclusions) of sediment which were pretty low in silica. These inclusions are portions of a great thickness of hornblende-garnet gneiss, frequently interbedded with limestone, of the Grenville series. This gneiss is a basic rock generally carrying several per cent of magnetite; sometimes considerable hypersthene; and little or no quartz. It is quite likely that some of the closely involved limestone was mixed with the inclusions of sediment during the process of metamorphism. It will at once be seen that such an iron-rich, silica-poor sediment was very favorable for the development of large garnets under the conditions of great heat and pressure which were brought to bear upon the lenslike inclusions in the molten syenite or granite.

The hornblende rims or envelops are quite certainly great reaction rims around the garnets, but just at what stage of the metamorphism they were produced is not at all clear to the writer. The rounded character of the garnets shows pretty clearly that the rims of hornblende are of secondary origin and that they were formed sometime after the crystallization of the garnets and possibly at the time when the pressure producing the foliation of the rocks of the region was brought to bear.

In case number 4 (Hooper mine) a clew to the origin of the garnets is furnished by a study of the wall rock in the Rogers mine on Gore mountain. In this latter case the typical garnet-bearing rock (No. 1 of the accompanying table) of the mine passes by perfect gradation, through an eight or ten foot zone, into a basic syenite or acidic diorite (No. 2 of the table) which contains distinct dodecahedral garnet crystals up to over an inch across but always without hornblende rims. This rock, in turn, grades into a hornblende (quartzless) syenite (No. 3 of the table) which merges into the typical country rock of quartz, hornblende syenite, these

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two latter rocks being at times somewhat garnetiferous. The writer is fully convinced that this transition zone (wall rock) has been formed by assimilation or actual melting or fusing together of the syenite and the border of the great inclusion at the time of the intrusion.

TABLE SHOWING THE MINERALOGICAL COMPOSITION OF THE MATRIX OF THE GARNET-BEARING ROCK IN THE ROGERS AND HOOPER MINES [1]

		Orthoclase	Plagioclase	Hornblende	Biotite	Hypersthene	Magnetite	Zoisite	Apatite	Pyrite	Zircon
Rogers mine.....	1	20	Lab. 20	40	3	15	1	1			
	2	30	Ol.-an. 30	36			1	2	little	1	
	3	50	And. 25	24				1	little		
Hooper mine.....	4	42	Ol.-and. 20	30	5	2		½			½
	5	30	Ol.-and. 35	33	½	½	1				little
	6	40	Ol.-and. 20	35		4	1				

[1] A close approximation to percentage by volume only is intended.

As shown in the field, in hand specimens, and in thin-sections the garnet rock (Nos. 4, 5, and 6 of the table) at the Hooper mine is almost exactly like the wall or transition rock of the Rogers mine, and it also appears to grade into the country rock. In each case the garnets never show reaction rims of hornblende and the garnets often show good crystal outlines. In the Hooper mine this transition or intermediate rock makes up practically the whole mass which is mined and is thus much more extensive than at the Rogers mine. All evidence points to the origin of the Hooper mine rock as due to rather thorough melting of an admixture of syenite and Grenville sediment where the Grenville inclusion was perhaps deeper down in the magma and hence subjected to much greater heat, or possibly a number of smaller hornblende gneiss inclusions, perhaps with some limestone, were assimilated by the molten syenite.

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THE USE OF THE STEREOGRAM IN PALEOBIOLOGY

BY GEORGE H. HUDSON

The earliest form of the stereoscope was devised by Sir Charles Wheatstone to illustrate the phemomena of binocular vision. This instrument was made known in 1838 and very simple line stereograms were drawn to accompany it. By a curious coincidence Daguerre succeeded in perfecting his photographic process during the same year and thus opened the way to the production of stereograms which would possess something more than a purely theoretical interest. Thus the stereoscope and the rather bulky and clumsy form of mounted stereogram developed together and the former became specialized or adapted for use with the latter only.

In these days of cheap and excellent methods of reproducing photographs there is no valid reason why stereograms should not be printed and bound together with descriptive text in book form. This would only be a step in the direction of "scientific management." It would save time now lost in keeping the loose stereograms in order, in finding the one desired and in replacing it after use. It would insure against loss and damage. It would open avenues for use now unfortunately closed. Stereograms could be made to illustrate books of travel, textbooks, scientific papers and popular magazine articles dealing with the world and its workers in all spheres of human activity from the mine to the stage. To open this new field we need only a stereoscope that shall rest on the page while being focused or adjusted.

This article has been prepared to demonstrate the desirability of using stereograms to illustrate scientific papers. The field chosen lies both in biology and paleontology. The illustrations are confined to a few species of sea stars but both recent and fossil forms are represented.

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As a temporary makeshift to enable us to see our plates as solids we will use the ordinary Holmes stereoscope in one of the following ways.

Let the observer seat himself before a table arranged to let a good light reach the page from the left side. In front and about ten inches back from the edge of the table place two or three moderately heavy books. Slide the transverse card carrier off the end of the rail of the stereoscope and place this end against the lower edge of the bottom volume. By now placing the forehead against the hood and using a gentle pressure it is easy to hold the instrument at an angle of about forty-five degrees and at the same time look through the lenses. Both hands are free to bring any stereogram into proper position and focus. The line separating the two views must be kept near the center of the rail and the lower edge of the stereogram kept parallel with the horizontal edges of the lenses.

This end may also be attained by placing the stereogram with its lower edge close to the edge of the table and holding it as nearly flat as possible with proper weights. Then hold the rail of the stereoscope vertically against the edge of the table and move up or down to focus.

For a quickly made but more permanent device, procure two pieces of board, one 10 inches x 12 inches x $\frac{7}{8}$ inch and the other 2 inches x 1 inch x $\frac{7}{8}$ inch. Fasten the smaller piece under the middle of one of the 10 inch edges, keeping the two $\frac{7}{8}$ inch faces flush with each other. A simple clamp will hold the rail of the stereoscope against this $1\frac{3}{4}$ inch face. Two or more elastic bands around the board will hold the volume to the stage and both hands may be left free for other work.

Still more desirable would be a large inclined stage with spring clips and a stereoscope body that could be focused by means of a rack and pinion as in a binocular microscope. A cheap and convenient form could be modified after Brewsters "box" stereoscope in which the loaded base of the instrument should rest directly on the printed page.

If the reader will seek through one or another of the means here suggested to view these stereograms serially and in

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relief he will realize that the advantages secured are of sufficient importance to warrant the use of this means of illustrating scientific papers.

In order to avoid unnecessary turning of leaves and consequent readjustments, the matter especially referring to each of the following plates has been printed on the page facing it.

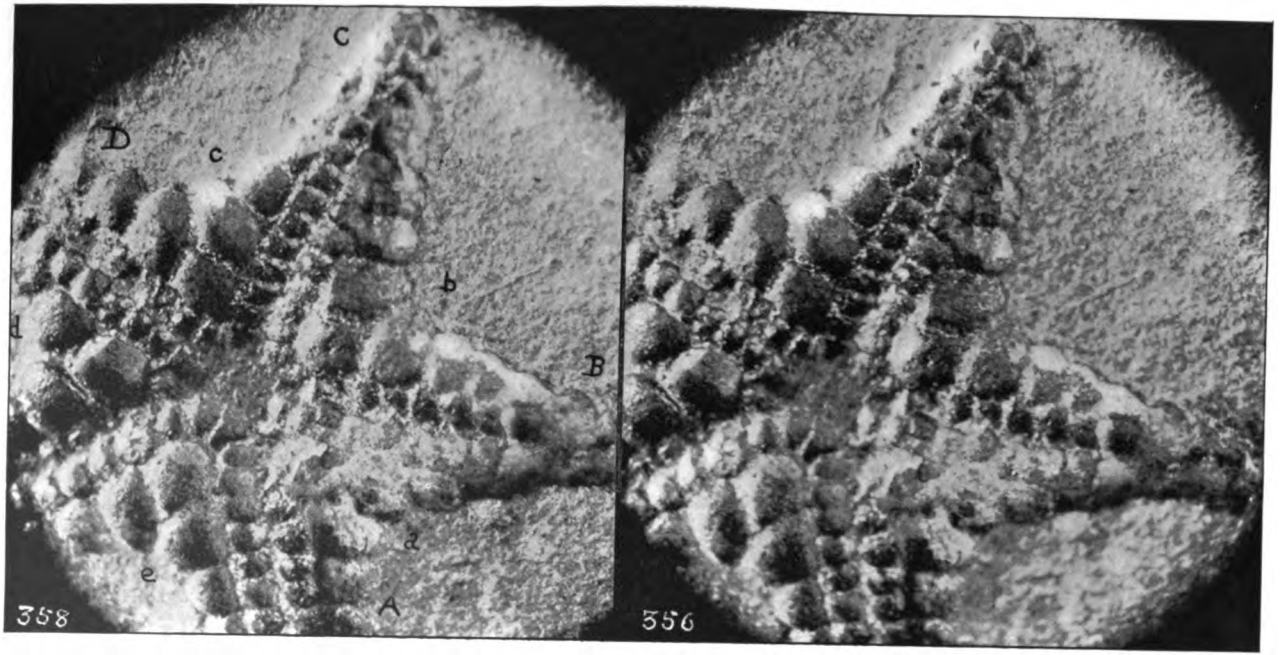
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Plate 1 Palaeaster parviusculus Billings x 9.5 dia. Canadian Nat. & Geologist, v. 5, no. 1, page 69 (Feb. 1860). From lower Arisaig series. Arisaig, Nova Scotia. The unique holotype in McGill College collection no. 1586

View first without stereoscope and note the white patches over interradius (*a*) and along the margins of arms (*B*) and (*C*). On viewing stereoscopically these are seen to be thin shells of calcite belonging to the surface of the oral ossicles and not yet completely removed from the mold. A perfect cast might show this loss from plate surfaces but the clear delimitation, here so easily made manifest by the difference in reflective power, would be absent.

These figures viewed without the stereoscope may present the appearance of either a mold or a cast, thus adding to the difficulty in interpretation. In both items the advantages of the stereogram are very pronounced.

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Plate 2 Palaeaster parviusculus Billings x 9.5 dia.

From a wax squeeze

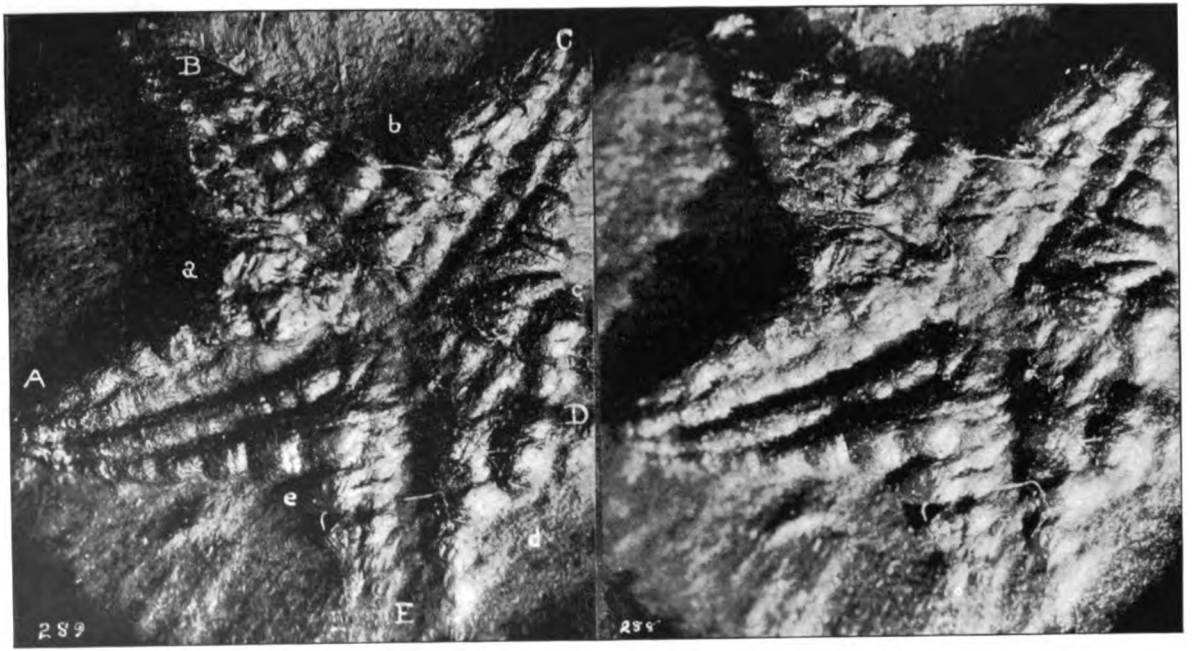
A squeeze is subject to certain serious defects. The mold may retain some imprisoned air or other fluid. The fluid that escapes from the mold under pressure may make deep folds or distorted channels in the plastic medium used. This medium must also flow out from under the place of greatest pressure and when any two portions of a stream meet in the lee of a projection they can not wholly obliterate the traces of the fold so produced.

In this squeeze one of the marginals, in interradius (*c*) is made to appear as three very distinct but irregular ossicles. Of minor prominence are the folds crossing the lower marginals and adambulacrals of arm (*A*). Still more minute are the numerous lines of flow leaving interradius (*e*) and radius (*E*).

In the Victoria Memorial Museum at Ottawa is a plaster cast of this species showing several adambulacra with central depressions suggestive of those shown in our plate 5, but caused by bubbles of air imprisoned in the deepest recesses of the mold.

The artifacts here enumerated are manifestly absent from the stereogram.

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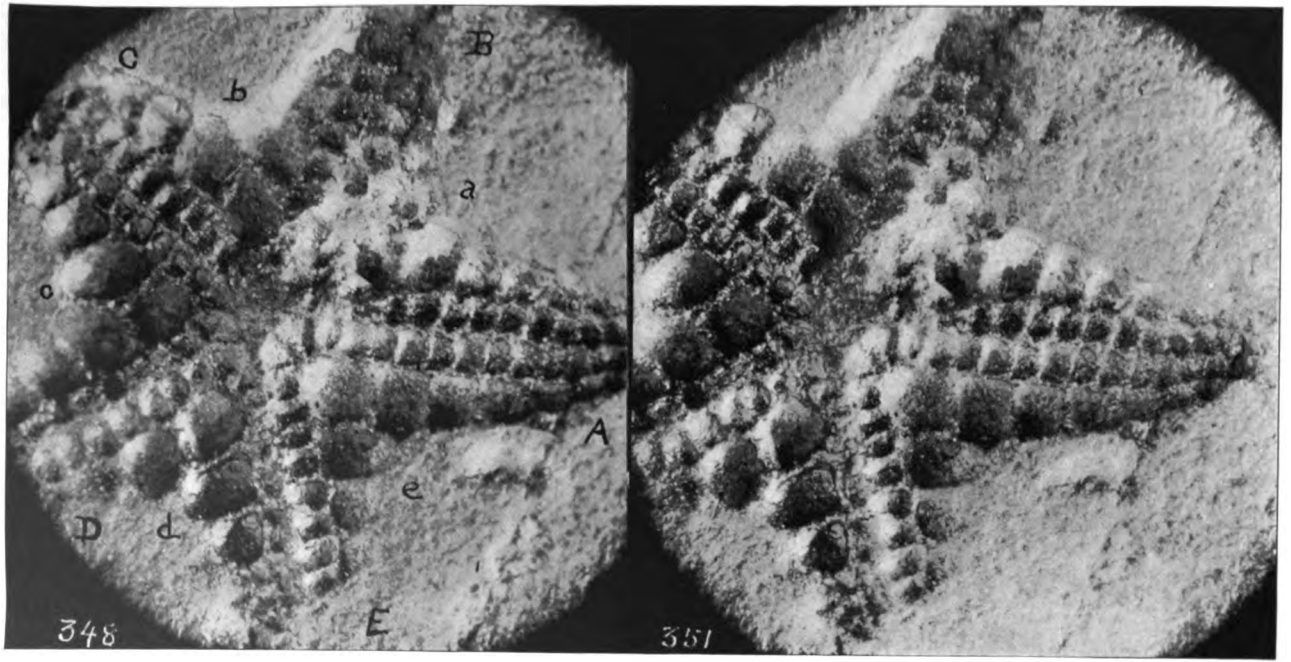
Plate 3 Palaeaster parviusculus Billings x 9.5 dia. From two negatives showing more of the detail of arm *A*. The left view has here been mounted as the right and vice versa, giving closely the appearance of a cast.

In interradius (*e*) note the flat oral surfaces of the pair of adambulacrals forming the " jaw " and their decided inclination toward the interior.

In arm (*A*), lower row of adambulacrals, note the elevated positions of the 3d, 7th, 9th and 11th; in arm (*B*) left row the 9th and in right row the 6th, 7th and 8th. Note also the cases of marked depression. This is evidence for a muscular system that could raise or lower individual adambulacra.

The oral faces of both marginals and adambulacrals seem to be minutely tuberculated and the marginals in places appear to show traces of recumbent small spines. The condition of the surface of the mold must be clearly understood, however, before definite conclusions are drawn.

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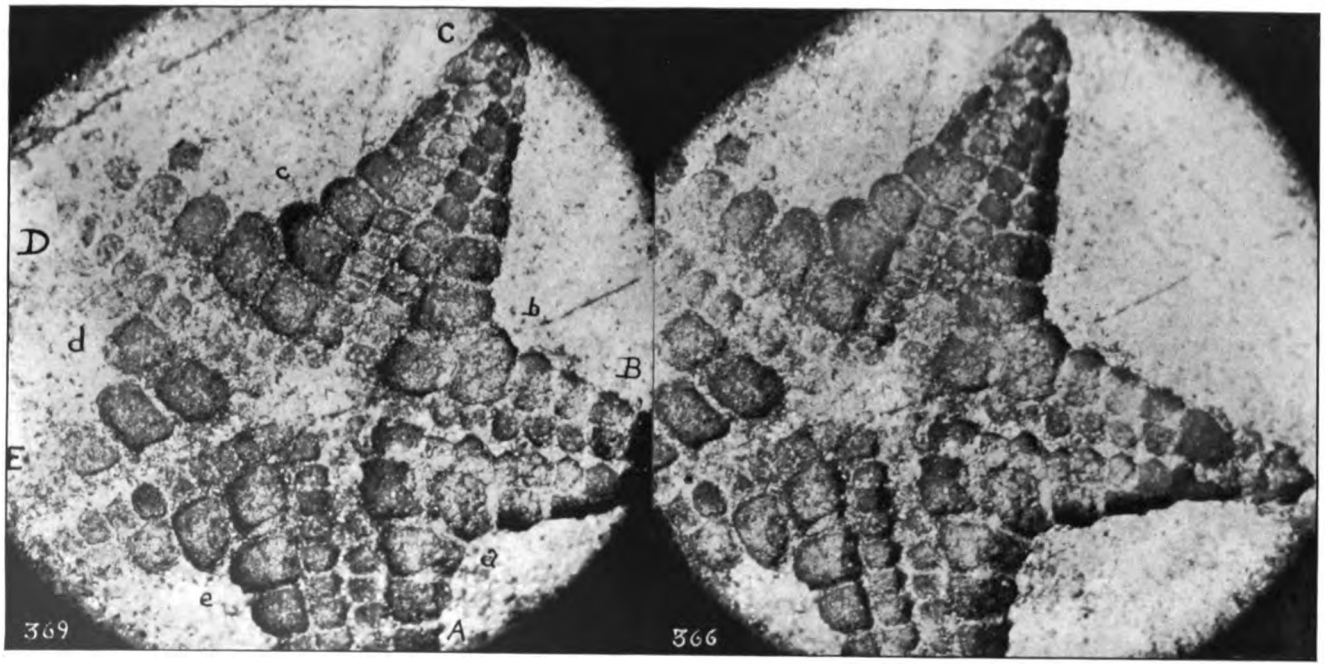
Plate 4 Palaeaster parviusculus Billings x 9.5 dia. Photographed under gum damar.

In order to secure a still better representation of the plate surfaces the thin shells of calcite were rendered transparent by mounting with gum damar. The remains of a blackened integument covering the oral surface and slightly descending between the ossicles, as folds, is here made manifest. Plate boundaries are now more clearly defined.

Note that where the adambulacra are in opposite positions, as in the outer portion of arm (*B*), they leave a single medial row of small diamond-shaped openings. Where they are placed alternately they meet those of the opposite row still more closely and the diamond-shaped openings are closed. If this species possessed true ambulacra they were completely hidden in this closed condition of the arm. It is evident that individual adambulacra were permitted a small radial motion, orad or aborad.

With the mold itself for study, Mr Billings made out "twelve or fourteen" adambulacra "in each row." Plate 3, arm *A*, shows sixteen. He wrote, "and they seem to be continued round the edge of the oral plates." We need express no doubt about this. We are also enabled by these new methods to note many other interesting details that Mr Billings could not see with the specimen itself in hand. For his purpose these stereograms would have served better than the type.

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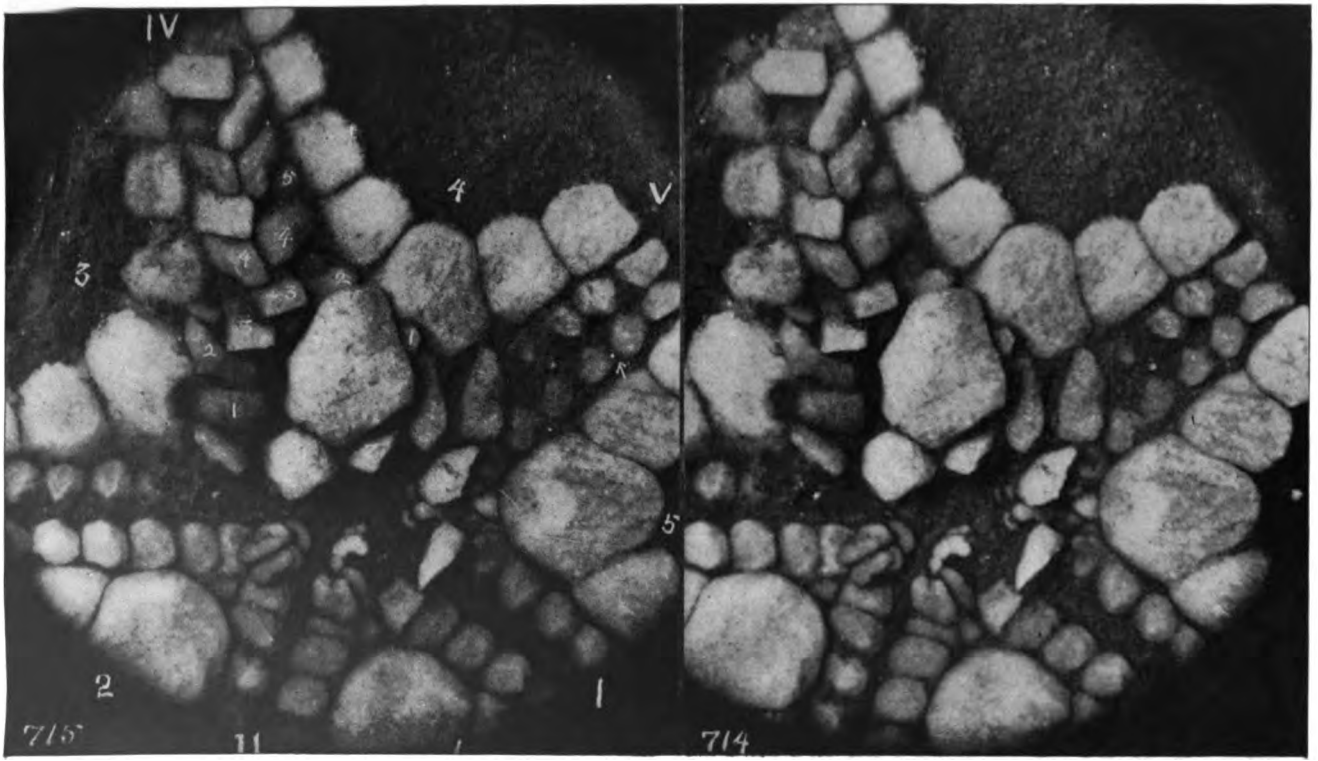
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Plate 5 Protopalaeaster narrawayi Hudson. x 10 dia. Photographed under gum damar. Ottawa Naturalist, volume 26, pages 21–26, 45–52., May, June, July, 1912. Lower part of Black River limestone, Ottawa, Can. Holotype in private collection of Mr J. E. Narraway, Ottawa.

Note the " covering plates " of arm IV. These are continued around and partly over the single interradial marginals as shown in interradii 3 and 4. Under each interradial pair, a pair of peculiar plates (" secondary jaws ") are seen in position in interradii 2 and 5 and displaced in interradius 1. Under these again are single, apparently crescent-shaped ossicles which appear to have been attached either to a secondary jaw or to an interradial pair of adambulacra (see interradius 1). In interradius 1 the crescent-shaped ossicle appears to be connected with a portion of an aboral covering consisting of some fifteen or more minute ossicles having a diameter of about 0.1 mm each. Note the flat or bevelled surfaces of the pairs of adambulacra forming the jaws in interradii 1 and 2 and the slope toward the mouth precisely as in P. parviusculus. Three ossicles with others now lost were thrust over this specimen from interradius (4) as is shown by the displacement of the two 3d covering pieces in arm IV, the interradial covering pieces in interradius 4 and the displaced pair of " secondary jaws " and oral in interradius 1.

The stereogram not only gives us an impression of depth but it may enable us to make very accurate measurements of the third dimension. In plate 5 a mote of dust settled on the cover glass over the fifth adambulacral of the lower row in arm V. The light reflected by this mote makes it appear as a white speck. As seen in the left view this speck lies between the fifth and sixth adambulacra; as seen in the right view it lies near the inner point of the fifth adambulacrum. The parallax is easily measured and with the angle of view known, here about 18°, the distance from the visible surface of the cover glass to the adambulacrum is easily computed. With a few depths known, the others are easily estimated. The greatest depth shown in this plate is 1.5 mm.

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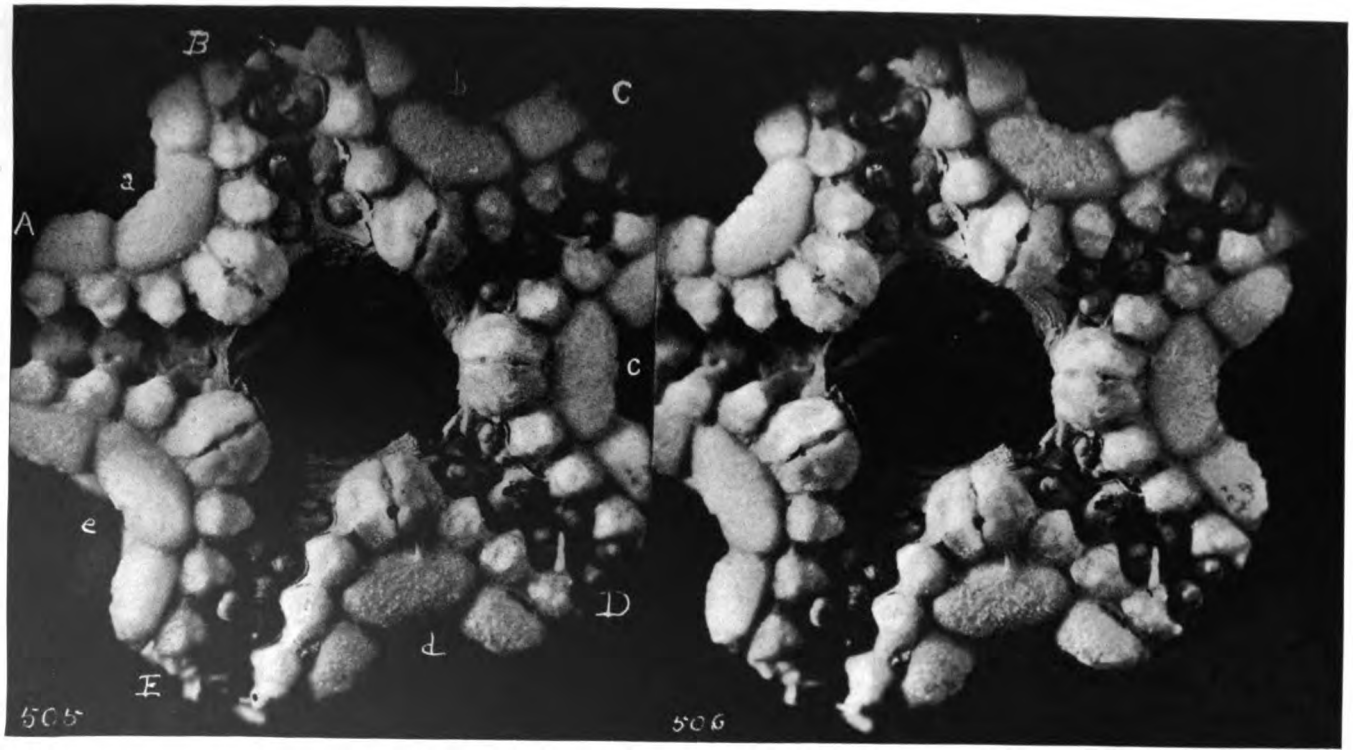
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Plate 6 Benthopecten simplex Perrier, oral aspect x 10 dia. West Indies, 1323 fathoms. Specimen from Museum of Comparative Zoology, Cambridge.

This specimen was loaned by Dr Hubert Lyman Clark, who called attention to its apparent close generic similarity to P. narrawayi. This plate and the two which follow it are here presented to emphasize, first, the need and value of more careful comparison of ancient and recent forms of life; second, to show that published stereograms may be made to foster such study; and third, to illustrate certain advantages of the gum damar mounting. As the fossil forms ought to have a message for students of recent material and the recent forms a message also for paleobiologists, no special argument is here needed to support the first proposition. For the second, compactness; ease of comparison; freedom from effort to assemble rare and scattered types; saving of time; saving of rare specimens themselves from loss or damage; possibility of reconstruction by models of forms after loss by fire, or accident; and the truthfulness of the stereogram itself, should be sufficient recommendation. To appreciate the changes produced by the damar mounting, this plate should be carefully compared with the next.

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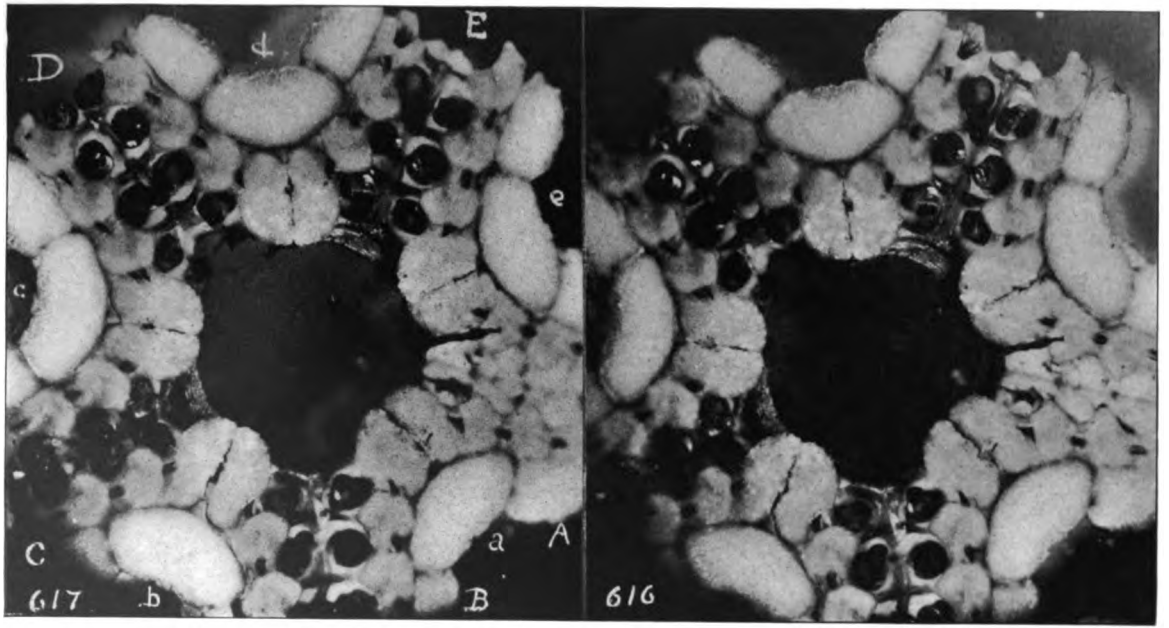
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Plate 7 Benthopecten simplex Perrier, oral aspect under gum x 10 dia.

We have here lost the outer light reflecting surface of minute granules, and have rendered transparent a thin outer layer of the ossicles and of some of the tissues associated with them. Portions of the preserved softer parts, here seats of muscular activity, are rendered in black. Three kinds of tissue seem to be clearly differentiated, that of the ossicles, a ligament like tissue connecting an adambulacrum with its neighbors in the same row, and a scattered muscular system of fine separate fibers.

At the end of arm *E* an adambulacral has been removed and we see a pit in the articulating surface of an ambulacral, filled with fine black fibers. That the adambulacrals possessed corresponding pits is revealed by the darkening of the plate centers which shows them to have been thinner in this portion. The mouth plates are formed by the interradial pairs of adambulacra but to the orad edge of each there appears to be fused an additional piece. These fused pieces are suggestive of the peristomial covering plates of Protopalaeaster narraway i. An orad may be seen under the first pair (parted mouth plates) of adambulacra in interradius (*b*). A portion of a dark but almost transparent radial canal is seen in arm *E*.

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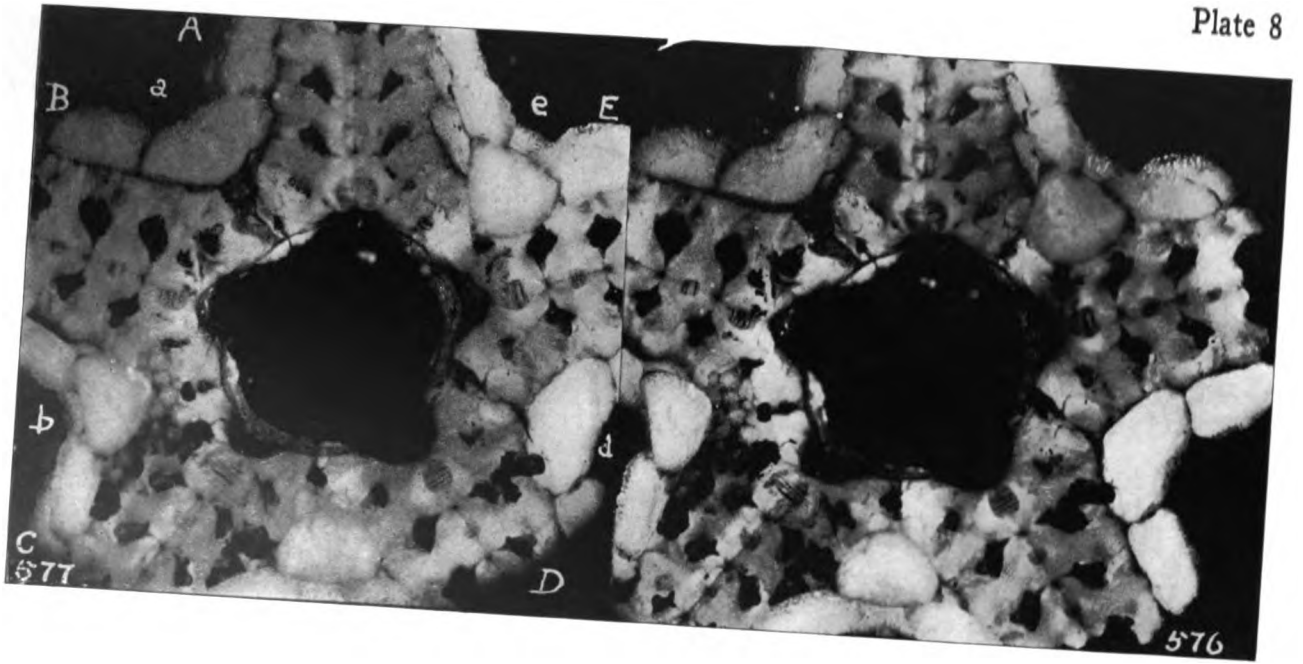
Plate 8 Benthopecten simplex Perrier, oral plates from aboral aspect, under gum x 10 dia.

In interradius (*d*) are seen a pair of ambulacral plates, which are inclined orad as if to support the fused distal pieces of the jaw plates, but which also have one shoulder recurved or arched to pass beyond the edge of the oral and support a proximal piece (first adambulacral) of the jaw plate. These first ambulacral plates do not meet their neighbors across the furrow but each is supported by a shoulder on the oral side of a second ambulacral. Each ambulacral, however, supports not only its own ambulacral but it also sends a small shoulder orad to in part support the next adambulacral. The strong ambulacra and weaker adambulacra both rest against the flattened inner wall of the marginals. Were the arms in a more contracted or closed position the oral aspect of this species would present a medial row of diamond-shaped openings for each arm and if Palaeaster parviusculus possessed ambulacra, its oral skeleton must have been remarkably like that of Benthopecten.

The added transparency secured by the gum process is very manifest in working with fossils. Aside from the effects secured in plate 4, we should also note the transparant surfaces of the ossicles in plate 5, interradii 4 and 5. Buried black grains may be detected to a depth of at least 0.1 mm.

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Plate 8



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Plate 9 Palaeaster niagarensis Hall.

Detail of oral surface of disk under gum x 9.5. Paleontology of New York. Volume 2, pages 247–48, plate 51, figures 21–23. Cornell University collection, no. 7331. Niagaran. In the shale at Lockport, N. Y.

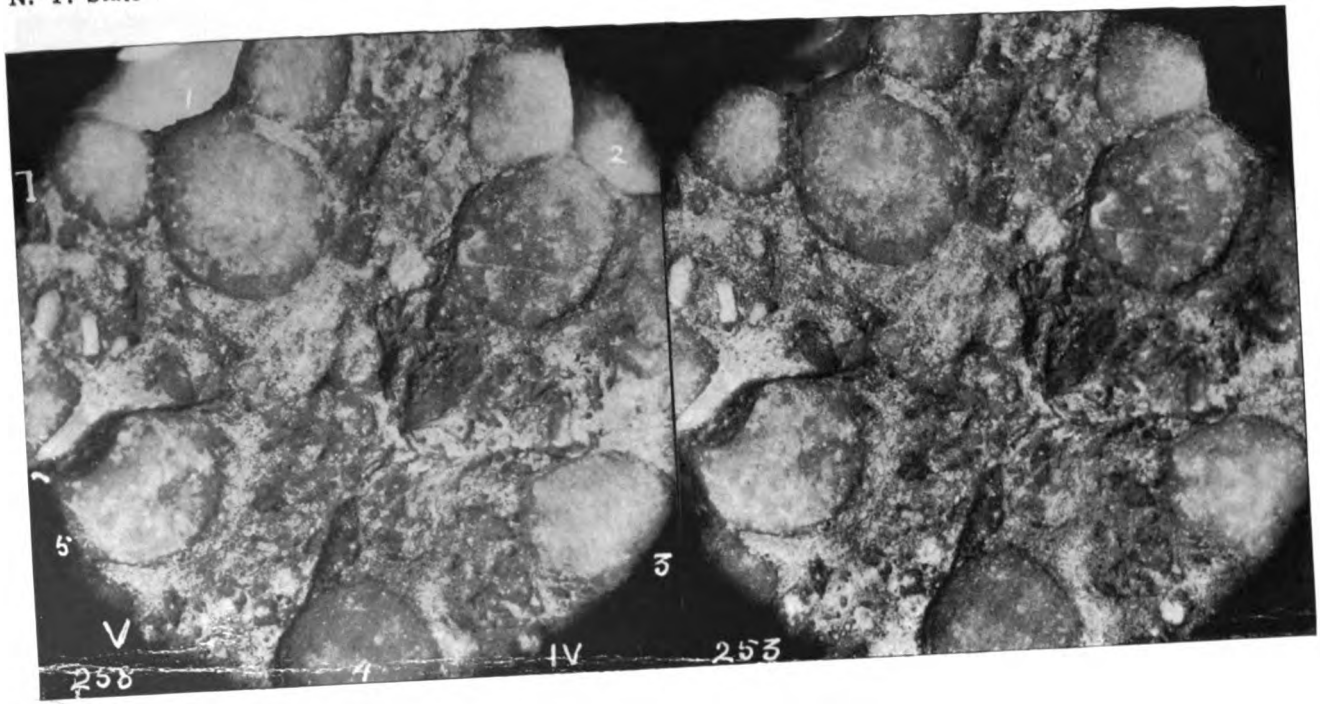
Pointing orad from the big marginal in interradius 4 is a dark, flattened spine that evidently was one of a pair which met each other with a straight inner edge. The " mouth plate " so formed was longer and more acute at tip than in Benthopecten simplex. These pieces can hardly have been highly modified adambulacra but they are remarkably like the pair of " covering pieces " which were seen in Protopalaeaster narraway i (plate 5, interradius 3). The attachment to the marginal seems to have been made by means of a granular flexible base allowing much freedom of movement. A second piece with its attachment carried away is present in interradius 2. The surface ornamentation of these pieces enables us to recognize fragments of others.

In radius III we may note two spines with widened bases that appear to have been supported by the sides of the interradial marginals and are still in position to cover the furrow.

The area exposed has evidently lost much valuable detail through the first crude efforts to " clean " this region. A careful development may still yield evidence of value, but the stereogram should be used to preserve all features it may be found necessary to remove.

For transparent effects from the gum mounting study the big marginals in interradii 2, 3 and 4.

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Plate 9 Palaeaster niagarensis Hall.

Detail of oral surface of disk under gum x 9.5. Paleontology of New York. Volume 2, pages 247–48, plate 51, figures 21–23. Cornell University collection, no. 7331. Niagaran. In the shale at Lockport, N. Y.

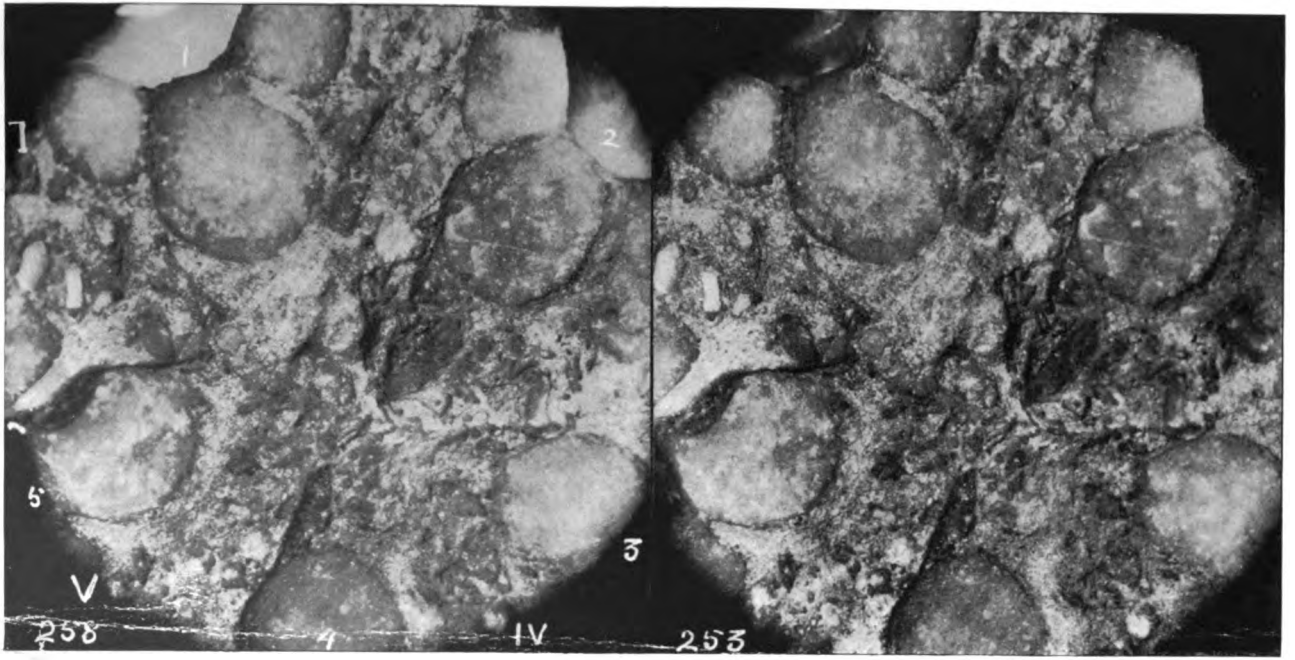
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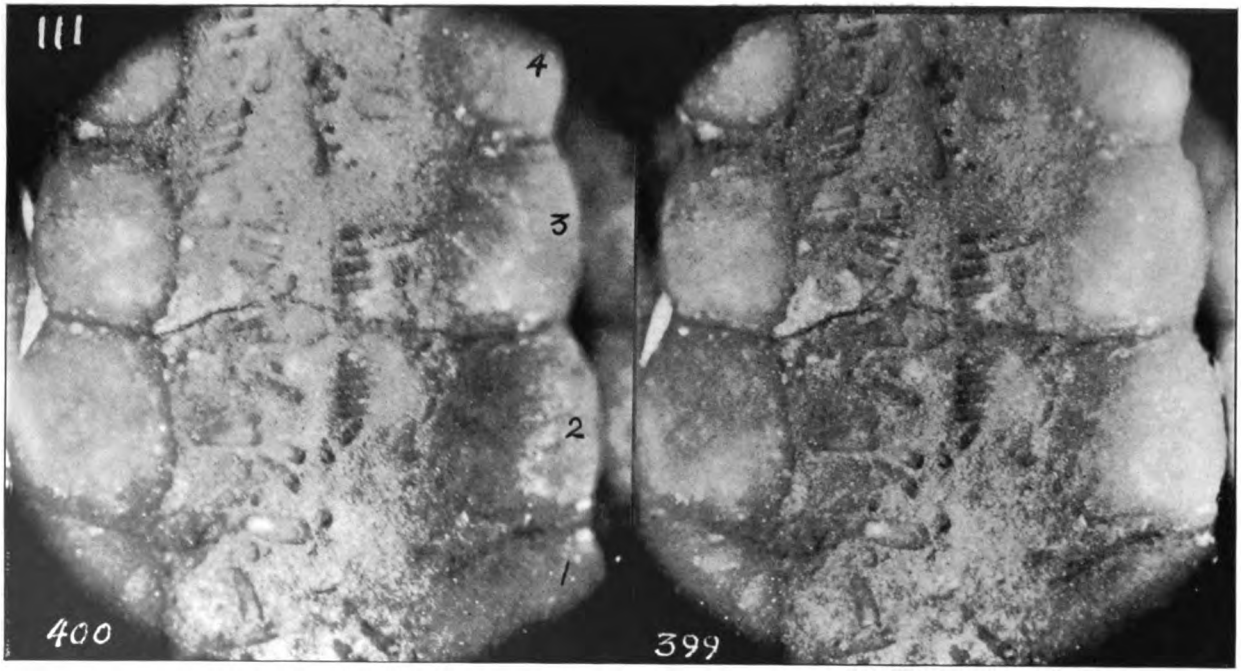
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Plate 10 Palaeaster niagaraensis Hall. Detail of the proximal portion of arm III oral aspect under gum x 19 dia.

Note the transparency of the inner portions of the marginal marked (2); the parallelism of fine elongated white flecks over arm at lower left of the plate; the three pointed depressions in upper left of medial line, which may be artifacts; the larger spines in lower half; the border of black fragments around the inner edges of and between the marginals marked (1) and (2); and the medial double row of small spinelets arranged in combs containing some seven or eight each.

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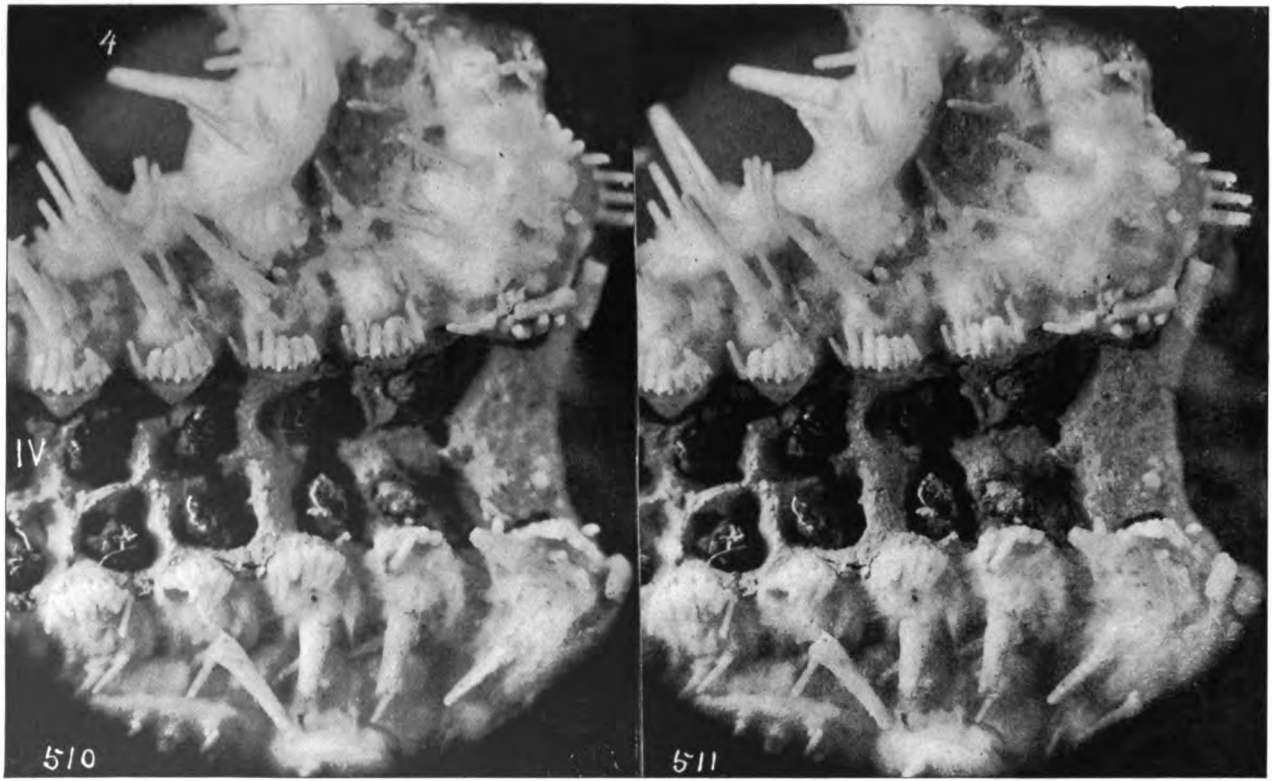
Plate 11 Benthopecten spinosus Verrill. Oral view of proximal end of radius IV x 10 dia. Off Delaware, 1186 fms. Museum of Comparative Zoology, Cambridge.

Here again we have evidence for ease and value of comparison of living with fossil forms. According to Professor Schuchert's time table,[1] P. niagarensis lived about 22,000,000 years ago, yet the furrow combs of the present B. spinosus are almost identical in number of spinelets (6 and 7), length, position on the adambulacra, mode of attachment and manner of carrying. In P. niagarensis the spinelets were more slender. The feeding habits were doubtless similar and the specialization through adaption already wonderfully perfect, even in that remote period.

It sometimes happens that a defect in a negative, print, or plate, may introduce a feature or so modify some line, or shading, as to lead to an erroneous interpretation. For instance in the left half of plate 5, interradius 5, the large marginal bears a line due to a scratch received by the photograph after mounting. This is nearly parallel with the lines in the ossicle itself. Its absence from the right-hand half shows it to be an artifact. Two different negatives taken at different angles would hardly introduce errors twice in the same place and could never so introduce them as to produce perfect stereoscopic relief. The very presence of such relief is positive evidence that we are dealing with a true feature of the specimen.

[1] Paleogeography of North America, plate 101.

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Plate 12 Palaeaster niagarensis Hall. Detail, oral aspect of arm V under gum x 19 dia. The adambulacra and the manner of attachment of the furrow combs are here well shown.

As a matter of interest and for the benefit of the art of illustration, we ought to compare this stereogram with Hall's figures 22 and 23 (op. cit.). The plates of Hall's report were beautifully drawn and the lithographic work was of very high character. It is the writer's desire, however, to point out that the best drawings ever made will neither reveal all the artist saw, nor will they reveal anything he did not see. The drawing also emphasizes certain features at the expense of others. On the other hand, the stereogram reproduced without retouching may be made to present all that can possibly be seen and (by modern methods) much that could never be seen otherwise. For example, in Hall's figure 22 the combs have five spinelets only and they are attached to the marginals and project over the furrow. In this stereogram the combs are seen to have seven or eight spinelets, and they are attached to the inner edge of the adambulacra and project away from the furrow.

In these stereograms the author has been enabled to present some items he has seen but they are not distorted to make others see them *from his personal standpoint.* In the same stereograms also there is much that the author has not seen, but which may yet be recognized and found to be of value a hundred years or more hence. Can any form of illustration have a higher, truer or more lasting value?

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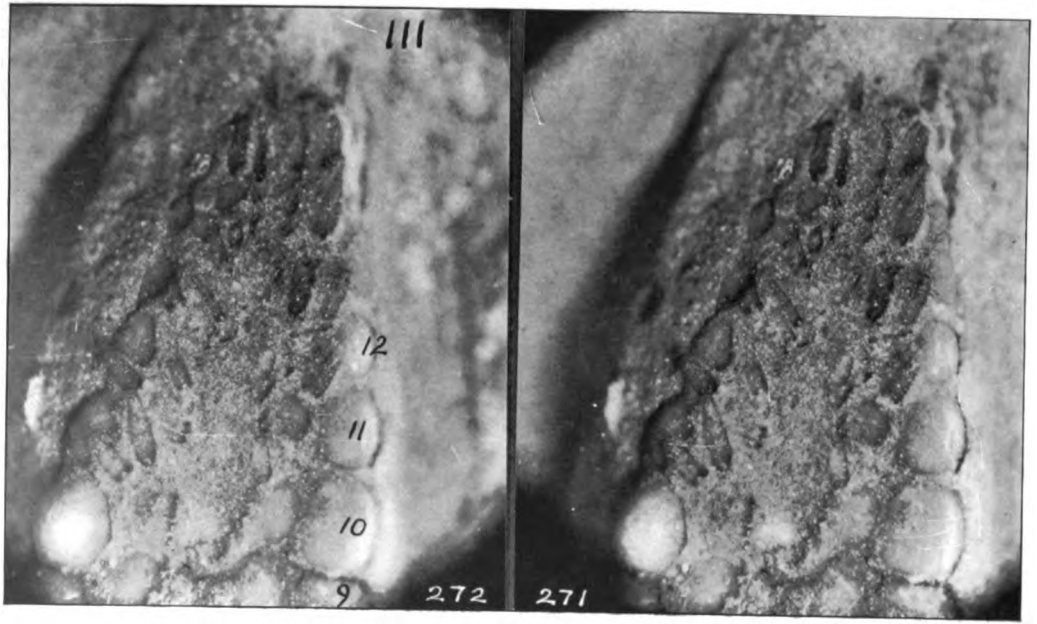
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Plate 13 Palaeaster niagarensis Hall. Detail of oral surface of arm III under gum, x 19 dia. It is evident from this stereogram that, in addition to the furrow combs, each adambulacral bore also two larger spines.

The stereograms illustrating P. niagarensis were slected from over forty made of this species. The numbers on the lower edge of the separate halves are the numbers borne by the separate negatives. Those who have kindly loaned material for study have had stereograms sent them and one writes, " I would rather have the stereogram than the specimen." If the type is a mold and therefore useless for development, a good stereogram ought to answer every purpose. The publication of such would therefore tend to render unnecessary the future loans of rare types and at the same time practically bring those types to the laboratories of thousands of students.

In closing I may call attention to the possibilities of penetrating the stone by invisible light waves and so revealing the entire specimen in stereoscopic relief, viewing as it were a transparent ghost of the species with various details of its internal structure. For example, I refer to the successful work of M. Pierre Goby of Grasse, France, in using the microscope in conjunction with such light, notice of which appeared in the Literary Digest, November 16, 1912, page 900. This subject is well worth the attention of paleobiologists.

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THE ORIGIN OF THE GULF OF ST LAWRENCE[1]

BY JOHN M. CLARKE

Present-day geography contemplates not only the surface of the earth and its forms of land and water, but considers also the physical and human causes that are modifying it. The geographer sees these things and looks forward; the geologist sees present conditions and looks backward for their inception — and then again forward in the perspective of cause and effect. It is hard to draw the line between these two fields of scientific interest. Some have tried to circumscribe each but it is a bootless effort. Each trenches on the other. At all events every geographer is something of a geologist. And this may be my justification in endeavoring here to find a clue to the origin of a geographic feature of so deep interest to us all as the Gulf of St Lawrence. We are very apt to take such a geographic fact for granted as it is and to let our geography end with a knowledge of its outlines, the contours of its shores and its bottoms. To unravel its history and to find the causes which have brought it into being is a task that will be fruitless on the face of the facts as they present themselves to the maker of charts. The key lies in the geological birth and growth of the whole land mass by which such a body of water is embraced.

So to find the real factors in the making of this classical and romantic body of water, we shall have to go well back to the early events in the making of the land.

Fundamental among these facts is the existence of the great mass of crystalline rocks that sweeps from Labrador to the Laurentides and northwestward to Alaska — the Canadian shield — as a continental land mass rising above the waters of the primitive ocean. Its shores were washed by the first sea whose life records have been kept for us in the sediments which, now changed to shale, sandstone and limestone, bound all its ancient shores. On the south coast of this Canadian continent, in the ages of its independent existence, lay, in the longitude of Montreal, a great tongue or peninsula which forms the Adirondack mountains of New York; and still farther south, perhaps, were long and narrow land masses that kept their uncertain heads above water for no great time. About these con-

[1] Reprinted from Bulletin de la Société de Géographie de Québec, v. 7. January 1913.

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tinental and insular shores and on the bottom of these shallow intervening seas were laid down, to hundreds and even thousands of feet, the sediments of the ocean filled with the remains of living beings that played out their days in succession as unknown time rolled by. Thus the shallow sea became overloaded with its burden of deposits — a load of soft and plastic material made still more yielding by being carried constantly farther downward into regions of higher heat as the later deposits continued to pile on top of the earlier. Against this soft and weakened mass of deposits stood, on one side, the great weight of the waters in the vast Atlantic ocean basin, pressing upon them landward, and on the other, the irresistible crystalline continent — the Canadian shield.

The outcome was inevitable; the whole mass of sea deposits was slowly turned up into great mountain folds and troughs — not all at once but slowly, fold after fold, to unmeasured heights, and often the folds at the south were thrust upon and over folds at the north. Thus, broadly and rapidly speaking, the Appalachian system of mountains was built up through the ages, not at any one time in geological history, but beginning slowly and early at the north and ending late at the south. In the early development of this structure the shove of the soft rocks against the crystalline shield was so valiantly withstood at the north, that there, along the southern outline of that shield, from Lake Ontario to Natashkwan, the softer rocks broke down, making, where the two lay in contact, a deep and broad fracture extending from southwest to northeast. The existence of this break or fault in the rocks was long ago signalized by Sir William Logan[1] and it is known today as " Logan's

[1] One who has followed closely in the footsteps of Sir William Logan in his geological work in eastern Quebec may perhaps be permitted, without impropriety, to revert to the extraordinary achievements of this great Canadian, and his distinguished services to geological science.

The year after Sir William organized the Geological Survey of Canada, he began his official career by explorations in the Gaspé peninsula. Laboring in the early 40's among the picturesque sea cliffs of that inviting country, traversing its wildernesses, he determined its geological systems with their wealth of unrecorded facts and made of the Gaspé country ground that will always be of classic worth to geological science. Had he done no more, he would have served well; but he did do vastly more in the development of the mineral resources of the Dominion. A country that is rich and strong and great will not forget its obligation to such a distinguished servant. France, it is said commemorates by public memorials the services of its eminent civilians more often than it does those of its military and naval heroes. Such a memorial to Logan is wanting. There stands a rock cliff in the heart of the

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fault." It is beyond doubt the determinant factor in the existence and course of the St Lawrence river. "Logan's fault" gave birth to the river by setting down a line of weakness along whose crushed and broken rock masses the continental waters draining to the sea could find their least obstructed passage; and thus began the oldest of all great rivers of the earth and the oldest of all rivers on the earth of which we have any definite record.

The Appalachians of the Eastern Townships follow the normal northeast-southwest course, but in Gaspé, as every one knows, they swing about into a curve like a swan's neck or the upper line of the letter S. There the northern mountains end at Cape Gaspé on the land but their vanishing point can be followed some fifteen miles off to sea southeast, to the rocky shoal known on the charts as the "American bank." This mountain ridge or orogenic axis at the north is unlike that of the Appalachian ranges at the south. The ridges of these ancient mountains cross Nova Scotia in the normal trend; their southwesterly extension off New England is largely buried beneath the sea, and to the northeast they continue on their course across Newfoundland. Looking at the sketch map adjoining, one sees the different curves of these mountain axes at north and south and between them an area which we must believe was less involved in the profounder or axial movement of these disturbances — the region of central and northern New Brunswick. We are speaking of times and conditions when there was no Gulf of St Lawrence, when the elevation of the mountains had brought, if not quite all, at least most of the land now at the bottom of the gulf, above the water line and the continent extended without break from the present eastern shores out to the islands and across to Newfoundland. For long this ancient coast line was a series of mountain folds between which the ocean waters entered in broad channels southwestward, laying down the deposits of their own time in their due succession. But from the time the most ancient of these mountain folds were made, when the ridges at the north took on their singular curvature, the whole area between their end and the mountain axes to the south became an area of weakness and instability. This sigmoid curve at the north is a factor of profound meaning in the making of the gulf. It seems to be due to

village of Percé, overlooked on one side by towering sea cliffs and on the other by consecrated mountains over which Logan labored in his early work, and here might well be placed a tablet commemorative of the lasting achievements of his great career.

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the recoil, as one might say, of the softer rocks in their pressure against the irresistible Canadian shield, so that the line of fracture or fault was deflected at its outer end southward in such a way as

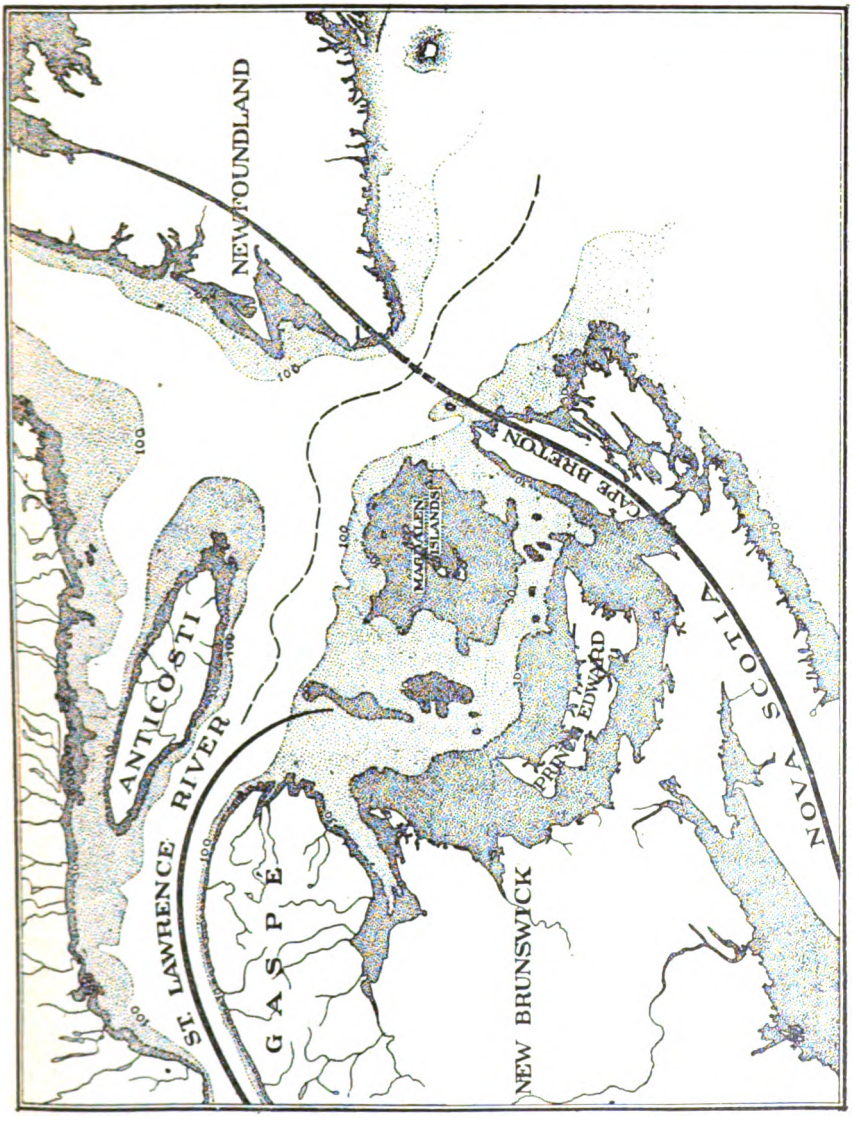


Chart of the Gulf of St Lawrence and adjoining lands

(The areas of the bottom down to 30 and 100 fathoms are indicated by close and coarse stippling. The broken curved line through the gulf is the line of greatest depth. The heavy black lines are the orogenic or mountain axes at north and south.)

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to break through the mass of sedimentary deposits. Thus the St Lawrence river has almost of necessity an outer curve that follows the course of the fault and of the folded slate and limestone mountains of Gaspé, while to the north of the fault line and the buried river channel lies the island of Anticosti whose rock strata, full of fossils, lie almost horizontal and were beyond the influence of the mountain making.

This revulsion from the north projected the axial line of resistance southward against the normal course of the other folds and protruded into them a disturbing antagonistic force. The Nova Scotia anticlines were beyond the reach of this projected influence but the folds between were disordered and crosscut and weakened. The picturesquely ragged coast at Percé is due to a complete collapse of a tremendous mountain fold which has vastly deranged the original succession of the rock strata.

The gulf lands had sunk low soon after the mountain-making period was over, and during the succeeding times of the Coal and probably even before, it was chiefly a vast drainage basin receiving fresh land waters with their heavy loads of sediment, then again elevated into a sand desert or great stretches of bars and dunes, and still at times depressed again so that the salt waters came in bringing their characteristic life forms. Then again, in later geological days, after the day of the Coal and the sand bars was over, the region was again elevated into land and the rocks of that land still fringe the gulf shores and make the islands of Prince Edward and the Magdalens.

The submarine course of the St Lawrence river across the gulf is still clearly indicated on the Admiralty charts; from its present mouth southeast it extends, far to the east of Gaspé, east of the Magdalen islands and thence outward to the Atlantic by the passage between Cape Breton island on the west and Newfoundland on the east (Cabot strait). This valley was made when the gulf bottom was land.

The chart accompanying shows the curves of 30 fathoms and 100 fathoms. It is very clear that the deep channel outside the 100 fathom line could not be made by the scouring of the present stream over the rocky bottom of the gulf. A more detailed chart of the gulf would show these depths dropping off from the shore in a succession of stages, or one might say terraces indicative of the gradual and periodical rise of the land bounding the ancient river while the river itself was cutting downward and narrowing its

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channel as the gulf lands rose. It is not to be conceived that this channel through the gulf is as ancient as the channel between the shores of Gaspé and the Quebec Labrador. The lands which the lower channel cuts are of later birth than those at the north and in its earlier stages we may believe that the river debouched into a shallow sea much as it does today into the gulf. The student of the chart will observe that there is a branch channel leading off in the direction of the Strait of Belle Isle but it is a shallower trough than that to the southeast. The line of deepest water is in the southeast channel and there is a difference in maximums of depth between the two of 155 fathoms, the greatest depth in the northwest trough being 145 fathoms and in the southwest 300 fathoms.

The southeast channel drops quite steeply 1700 feet below the broad 100 fathom plateau and this is twice the depth of the northeast course.

It would seem that the northeast course was a river valley of earlier date than the southern part of the southeast channel, that the river abandoned it for sufficient cause, possibly change in submarine level or blockage by a heavy ice sheet, and then continued to erode its present buried channel to still greater depths.

The courses of existing submarine currents over this region are not yet sufficiently determined to permit us to speak definitely regarding the outpush of the waters through the southeast channel and yet it is practically certain that this is the predominant trend of the major deep water movements of the gulf.

The Gulf of St Lawrence thus owes its existence chiefly to two determinant factors of very ancient date: the breakdown of the rocks which produced "Logan's fault"; and the curvature of the northern orogenic axis which effected a syntaxis or a protrusion of the northern against the southern Appalachian folds. The broken down basin between is a natural and resultant area of rock weakness which has had its short periods of low elevation above the sea, but longer periods of depression.

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A NOTABLE TRILOBITE FROM THE PERCÉ ROCK

BY JOHN M. CLARKE

The list of Lower Devonic species occurring in that spectacular cliff L'isle percée or Percé rock, has been given by the writer with some degree of fulness in his volume on the geology of Gaspé (N. Y. State Mus. Memoir 9, part 1, 1908). Among these species several trilobites of interest have been described. These accounts were based upon the collections made during several seasons of diligent work, and subsequent search has not materially added to the census of the fauna. The past summer, however, brought to light two specimens of a commanding Homalonotus, a genus not hitherto recorded from any of the Devonic outcrops in Gaspé county, and not only its presence but the character of the species itself is worthy of note.

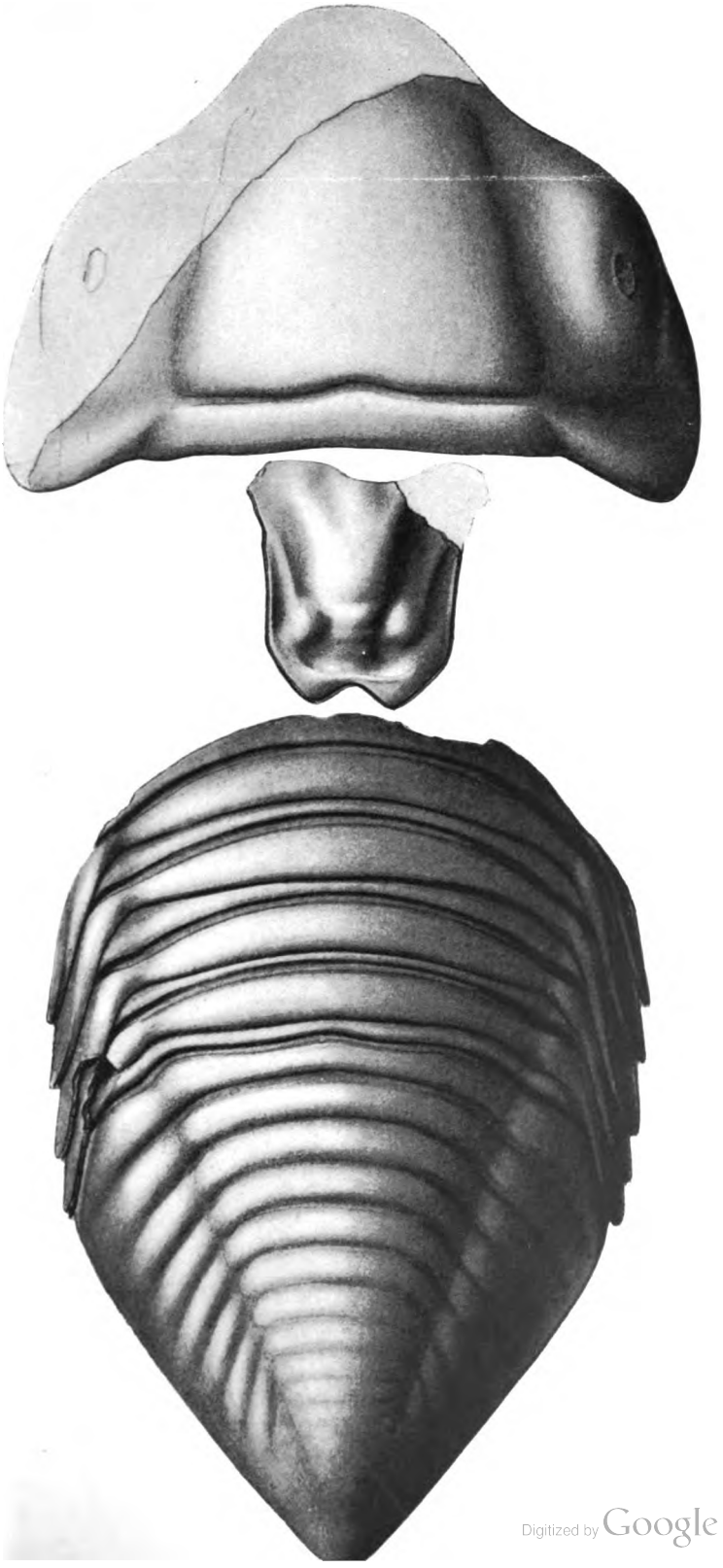
The Homalonoti of the boreal Paleozoic regions in America are distinctively characterized by their freedom from dermal overgrowths. They carry no spines or tubercles on any part of the test. This is a statement subject of course to the limitations of our pretty considerable knowledge of the Paleozoic faunas on this continent and while applicable here, it can not be so broadly stated for the boreal Palezoic, particularly Devonic, Homalonoti of the eastern hemisphere. There are European species of which the Siluric H. knighti and the Devonic H. armatus are leading and almost sole examples, whose test is spiniferous or tubercled, while the predominant species are devoid of these growths as in America.

The armate Homalonoti are on the whole quite distinctively austral, especially in their Devonic distribution. Witness of this is the great abundance of H. herscheli Murchison in the South African Lower Devonic[1] and at the same horizon in the Falkland islands.

There is an abundant and often beautifully preserved species in the Lower Devonic shales of São Paulo, Brazil, termed by the writer H. noticus, which is free of spines save for one conspicuously developed on the epistoma, a structure which is present in H. herscheli, but absent in all boreal species.

[1] The large number of species of this genus described by the writers on the South African Devonic has seemed to me not justified by evidence, except for provisional purposes.

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The species under present consideration conforms in these structures to other American Homalonoti and is to be directly compared with H. vanuxemi of the New York Helderberg and H. major of the New York Oriskany, accounts of which are to be found in Palaeontology of New York, volume 7. This resemblance is not unexpected in view of the many other affiliations of the Percé and Grande Grève Lower Devonic faunas with those of New York. The Percé Homalonotus is represented by specimens which indicate its large size. The largest known example of H. vanuxemi is a broken individual from Rondout, N. Y., and indicates an animal 280 mm in length, which is almost exactly the proportions of the Percé species. But even so large, these specimens fall far below the dimensions of H. major, the largest of all members of the genus. Yet there are, between these two species, few differences except dimensions, habitat and geologic horizon. In structure they are closely alike, the smaller H. vanuxemi occurring in the Helderberg limestones and lime shales and H. major in the Oriskany silicious limestones. The Percé species is rather better preserved and now better known in its details than either of the New York species mentioned, but its designation must show its affinity to them even at the cost of a multiplex name. I therefore venture so far as to express this relationship by the designation Homalonotus (v.-m.) perceensis.

The structure of the parts is indicated in the drawings which show the pygidium in normal convexity and entire, six of the eleven thoracic segments (all are preserved on a second but somewhat worn example), the head, partly worn away and the hypostoma. The obscurity of segmentation of the pygidium is characteristic and differential from other Devonic species, especially the common middle Devonic H. dekayi. The cephalon of H. vanuxemi-major has not been well made out and the hypostoma of this type is now seen for the first time, both of the Percé specimens showing this organ.

The author has shown the presence of H. vanuxemi in the Lower Devonic Moose River formation of Maine at Matagamon and Moosehead lakes.[1] Until now no representative of the genus has been known from points farther north.

[1] N. Y. State Mus. Mem. 9, v. 2, p. 67.

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ILLUSTRATIONS OF THE DEVONIC FOSSILS OF SOUTHERN BRAZIL AND THE FALKLAND ISLANDS

BY JOHN M. CLARKE

Three years ago the writer completed a protracted series of studies on the Devonic faunas of South America, especially those of southern Brazil in the state of São Paulo, and of the Falkland islands, incidentally also of the Cordilleras of western Argentina. These studies were authorized by the director of the Geological Service of Brazil, and the full discussion of these austral faunas is in course of printing as a memoir of that organization. Meanwhile, because of the delays attendant on publication in Brazil, and by permission of the director of the Brazilian Survey, occasion is here taken to present illustrations of the leading species of the Brazilian and Falkland faunas which are with propriety incorporated in this report on account of their intimate but contrasting relations to the Devonic faunas of New York.

While no other purpose is here sought than to set forth, as well as may be by illustration, the distinctive fossil characters of this southern Devonic and the whole estimate of the real significance of the fauna must be reserved for its more complete presentation and discussion, it is well to intimate that these Devonic faunas of the south and of the north, though united by general characters, are keenly and widely separated in the analysis of their specific and superspecific structures. This fact makes itself so clear that it is evident the northern and southern faunas developed in separated basins with but restricted intercommunication during the Devonic. These illustrations also indicate the continuity of the strand line and of the Devonic continents from southern South America to the Falkland islands and thence to South Africa.

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EXPLANATIONS OF PLATES

Plate I

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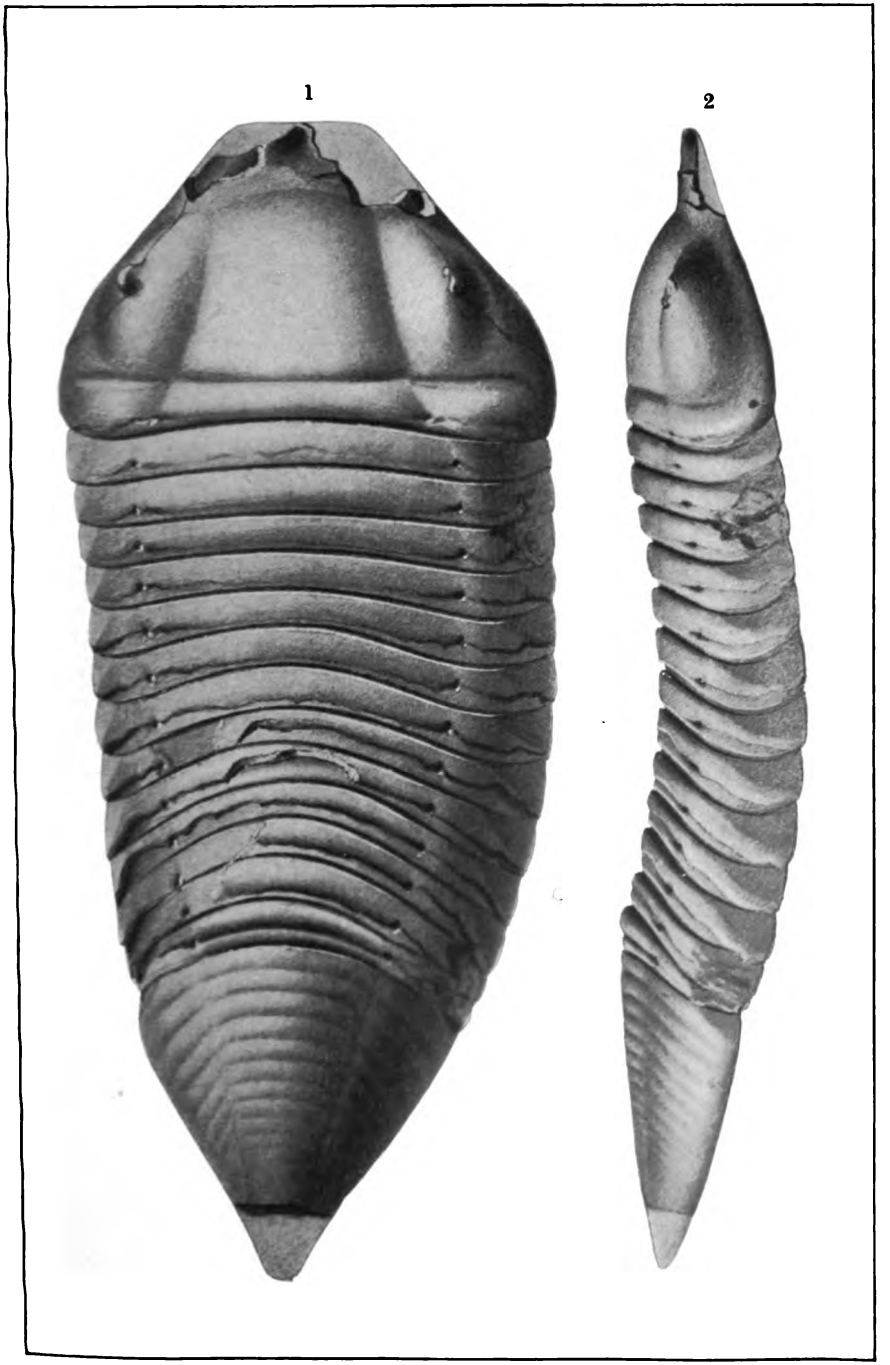
Homalonotus noticus Clarke

(See plate 2)

Fig. 1, 2 Dorsal and profile views of an extended complete individual of mature dimensions. This is essentially an internal cast, showing approximate normal convexity. The epistoma is exposed and the place of the anterior apiculus seen.

Locality: Ponta Grossa, São Paulo. Brazil

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Plate 2

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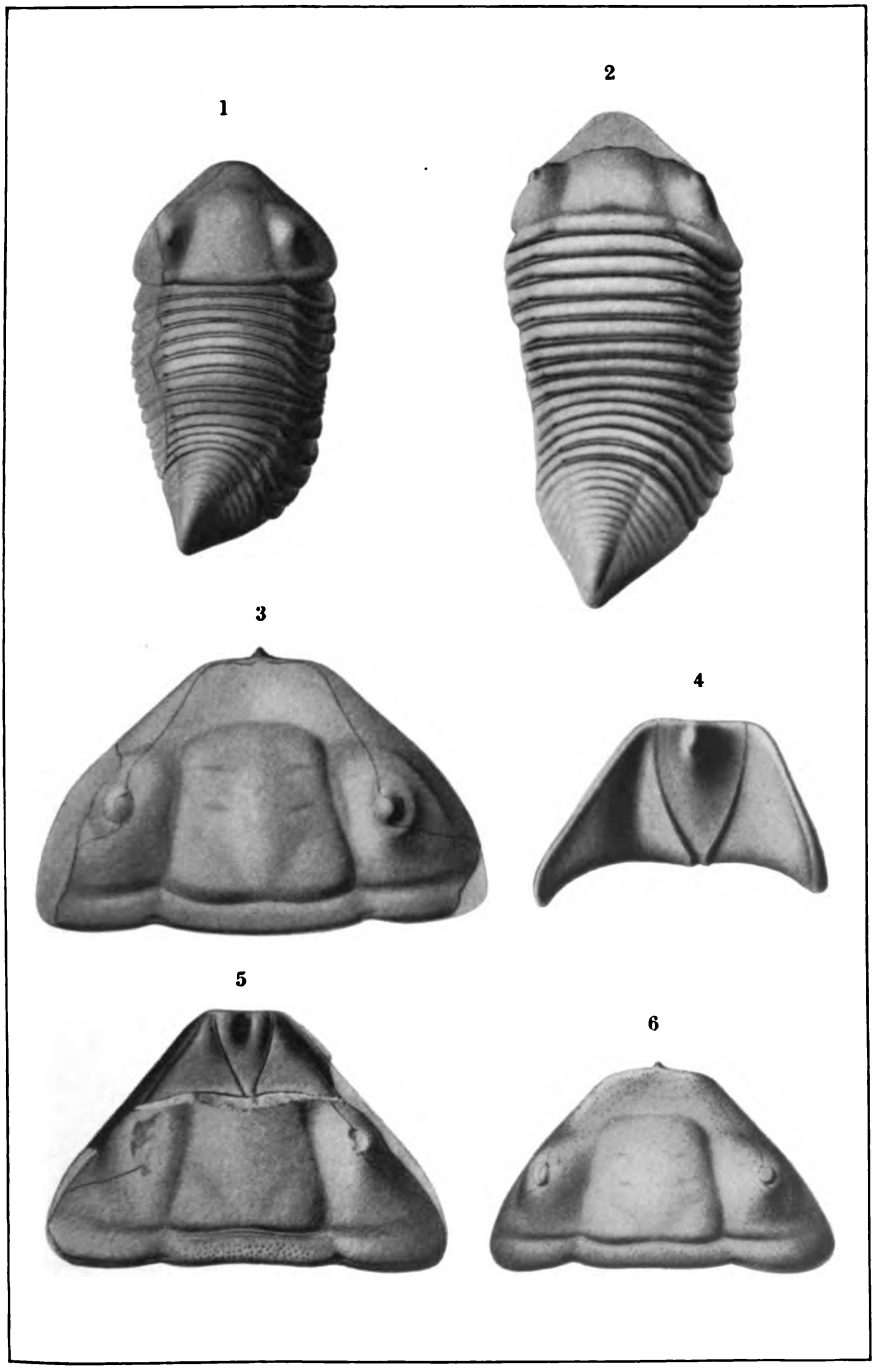
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Homalonotus noticus Clarke

(See plate 1)

Fig. 1, 2 Nearly entire small individuals
3 A large cephalon
4 The anterior doublure, epistomal plate and apiculus
5 A head with part of the anterior removed to expose the doublure and epistomal plate
6 An entire cephalon with apiculus
Locality: Ponta Grossa, São Paulo, Brazil

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Plate 3

145

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Homalonotus (Schizopyge) parana Clarke

Fig. 1 Pygidium and a few thoracic segments
2 A pygidium apparently lacking one segment
Locality: Tybagy, São Paulo, Brazil

Homalonotus herscheli Murchison

Fig. 3 A small head with apiculus and scattered tubercles
4 A series of strongly pustulose thoracic segments
5 A pygidium with a few tubercles
6 A large cephalon, nearly entire, of characteristic form, with spinous tubercles at the genal angles and traces of others on the glabella
Locality: the calc-nodules of Pebble island, West Falkland

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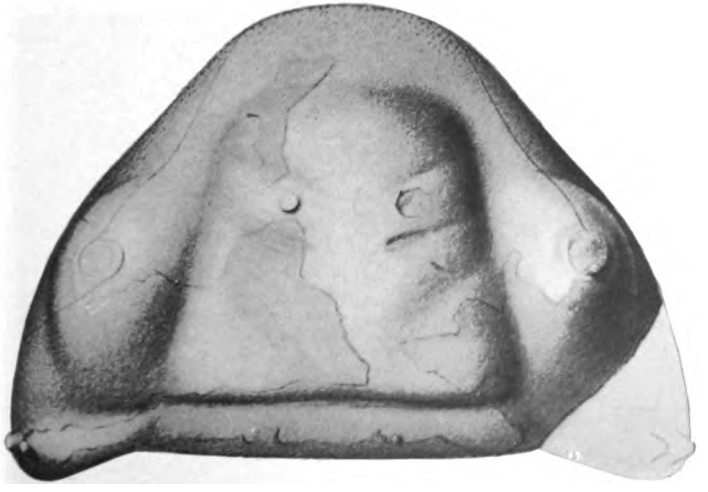

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Plate 4

147

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Dalmanites acacia Schwarz

Fig. 1, 2 Cephala showing the finely granulate surface, small eyes, nuchal spine and slight anterior projection
3, 4 Lateral and dorsal views of thorax and pygidium, showing the length of the erect thoracic spines
Locality: calc-nodules of Pebble island, West Falkland

Dalmanites falklandicus Clarke

Fig. 5 A normal cephalon with large eyes, short cheek spines and coarsely pustulose pygidium
6 Thorax and pygidium of this species
Locality: Fox bay, West Falkland

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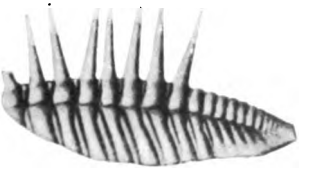
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Plate 5

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Plate 5

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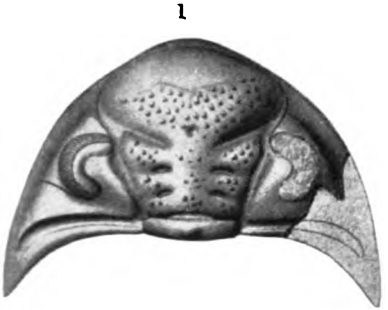
Dalmanites accola Clarke

Fig. 1 A nearly complete cephalon
2 A small entire cephalon with long genal spines
3, 4 Pygidia showing the uniform distribution of the pustules
5 An incomplete but undistorted individual with the missing parts restored in outline and showing their mutual proportions, arrangement of the scattered pustules, length of genal spines, size of eyes, etc.
Locality: Ponta Grossa, São Paulo, Brazil

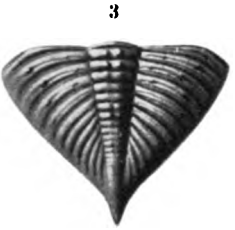
Cryphaeus ? allardyceae Clarke

Fig. 6 A somewhat weathered head and a thorax with pygidium from a calc-nodule. The association of these parts, though found disconnected, seems highly probable in view of their being the only fossils in the nodule and of their agreement in size
Locality: Pebble island, West Falkland

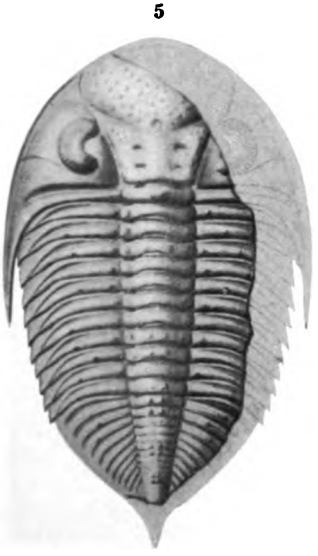
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Plate 6

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Cryphaeus sp. nov.?

Fig. 1 A pygidium with very blunt semicircular lappets, indicating a species distinct from the others here noticed. *Locality:* Ponta Grossa, São Paulo, Brazil

Cryphaeus australis Clarke

Fig. 2 A pygidium
3 A specimen displaying most of the parts except the pygidial fringe and showing the phacopid hypostoma
4 A nearly entire specimen
5, 6 Larger individuals partly crushed but restored in outline
Locality: Ponta Grossa, São Paulo, Brazil

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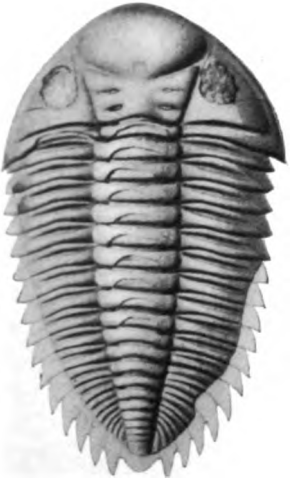
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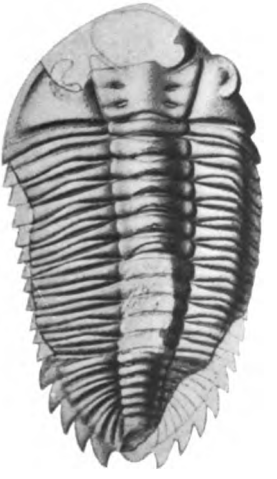
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Plate 7

153

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Dalmanites sp.

Fig. 1, 2 Dorsal and profile views of a cephalon allied to D. acacia and D. ocellus but departing in some structural details. The upturned genal angles are indicated in figure 2

Locality: from a calc-nodule sent to me by Prof. J. B. Woodworth with the note that it was found by Dr Thomas A. Barbour on the old beach of Lake Titacaca at Viacha, Bolivia, elevation 13,500′ A. T.

Calmonia ocellus (Lake)

Fig. 3, 4 Dorsal and profile views of a partly enrolled specimen
5, 6, 7 Three views of a coiled individual showing the characteristic head, small eyes, sharply pointed thoracic segments and a part of the pygidial fringe

Locality: Pebble island, West Falkland

8 An extended specimen incomplete at the pygidium

Locality: Mt Robinson range, Chartres river, West Falkland

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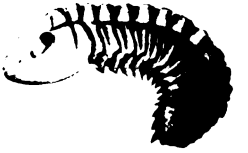
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Plate 8

155

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Pennaia pauliana Clarke

Fig. 1, 2 Cephala
3 A pygidium with two thoracic segments attached. x 3
4 The thorax and pygidium, showing the rounded ends of the anterior thoracic segments and 3 lappets of the pygidium
5 A nearly entire individual restored
6 Thorax and pygidium of an incomplete specimen
Locality: Ponta Grossa, São Paulo, Brazil

Calmonia signifer Clarke

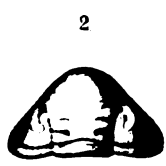
(See plate 9)

Fig. 7 Cephalon restored, showing style and position of the eyes and the small cheek spine
8 Anterior structure of the head showing the short apical projection which is often obscured
9 Internal cast of thorax and pygidium
10, 11 Pygidia with terminal spines
Locality: Ponta Grossa, São Paulo, Brazil

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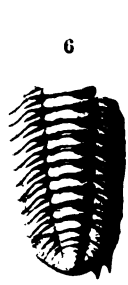

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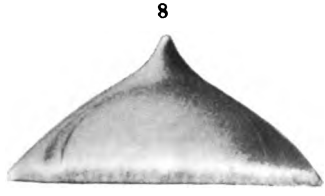

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Plate 9

157

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Calmonia signifer Clarke

(See plate 8)

Fig. 1 A large entire individual in which all the essential characters are well displayed. Attention may be directed to the short head, obscurely lobate glabella, small anterior eyes, angled extremities of the segments becoming sharper backward, the six pairs of pygidiae lappets and the relatively short caudal spine

2 A smaller entire individual with exsert genal spines and a longer caudal spine. The thoracic segments are only ten and one seems to be buried at the junction with the pygidium

3 Head and thorax

4 An entire but somewhat distorted specimen

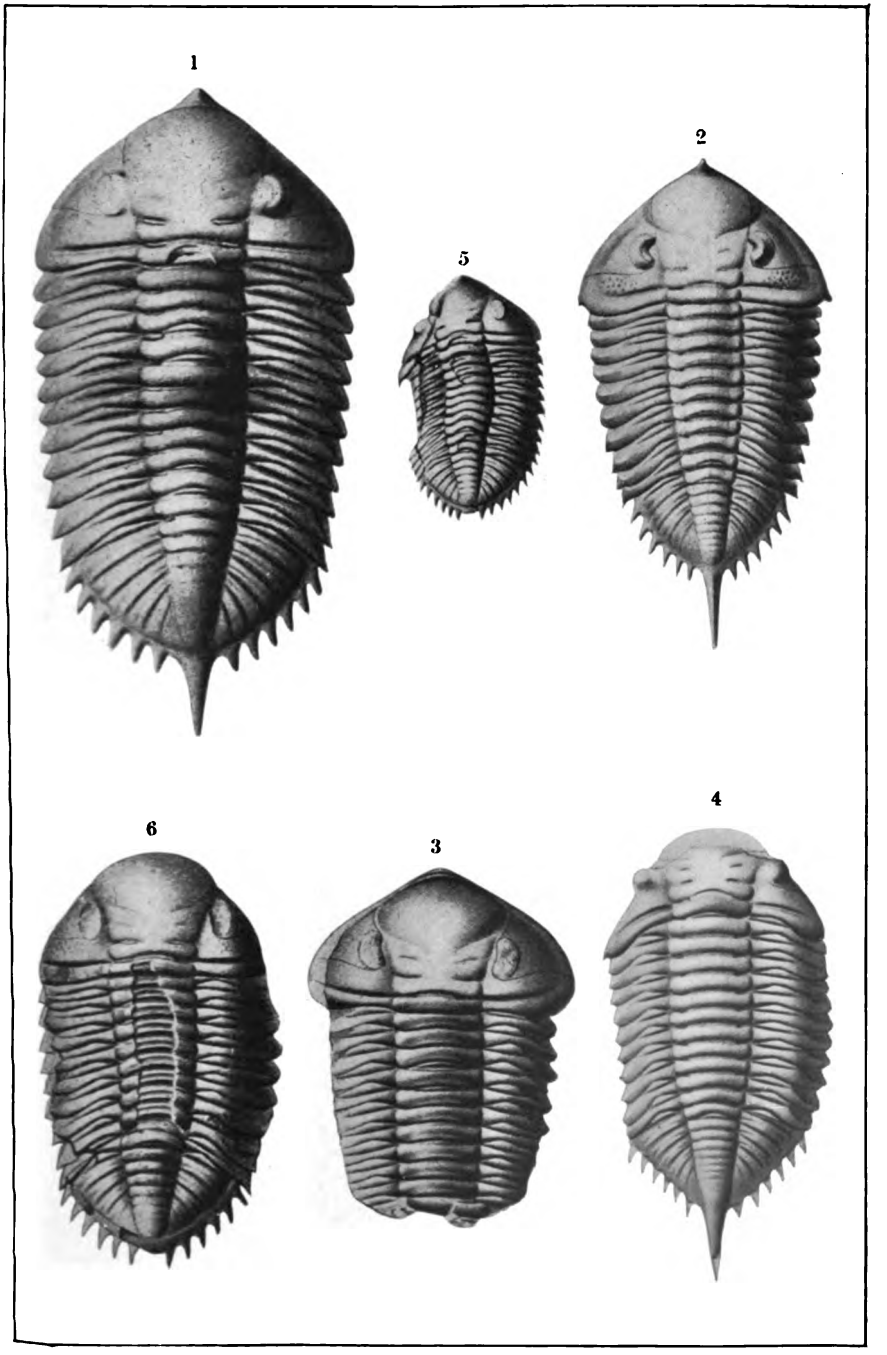
Calmonia signifer var. **micrischia** Clarke

Fig. 5 A small entire individual

6 A larger entire example

Locality: Ponta Grossa, São Paulo, Brazil

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Plate 10

159

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Calmonia subseciva Clarke

Fig. 1 An extended specimen from which the cephalon has been broken

2 A squeeze taken from the foregoing, showing the cephalic doublure and phacopid hypostoma. x 2

Locality: Ponta Grossa, Brazil

3 An entire specimen, slightly crushed about the head, showing the minute pygidial lappets

4 A nearly entire individual of large size

Locality: Jaguariahyva, São Paulo, Brazil

Proboloides cuspidatus Clarke

Fig. 5 A small cephalon

6 A laterally crushed specimen displaying a part of the proboscis, the sutural and genal spines and the acute spinules of the first thoracic segments

7 A cheek with sutural and genal spines. x 1½

8 A cephalon with its long proboscis, showing also the genal spine and base of the sutural spine

9 Large cephalon with proboscis broken

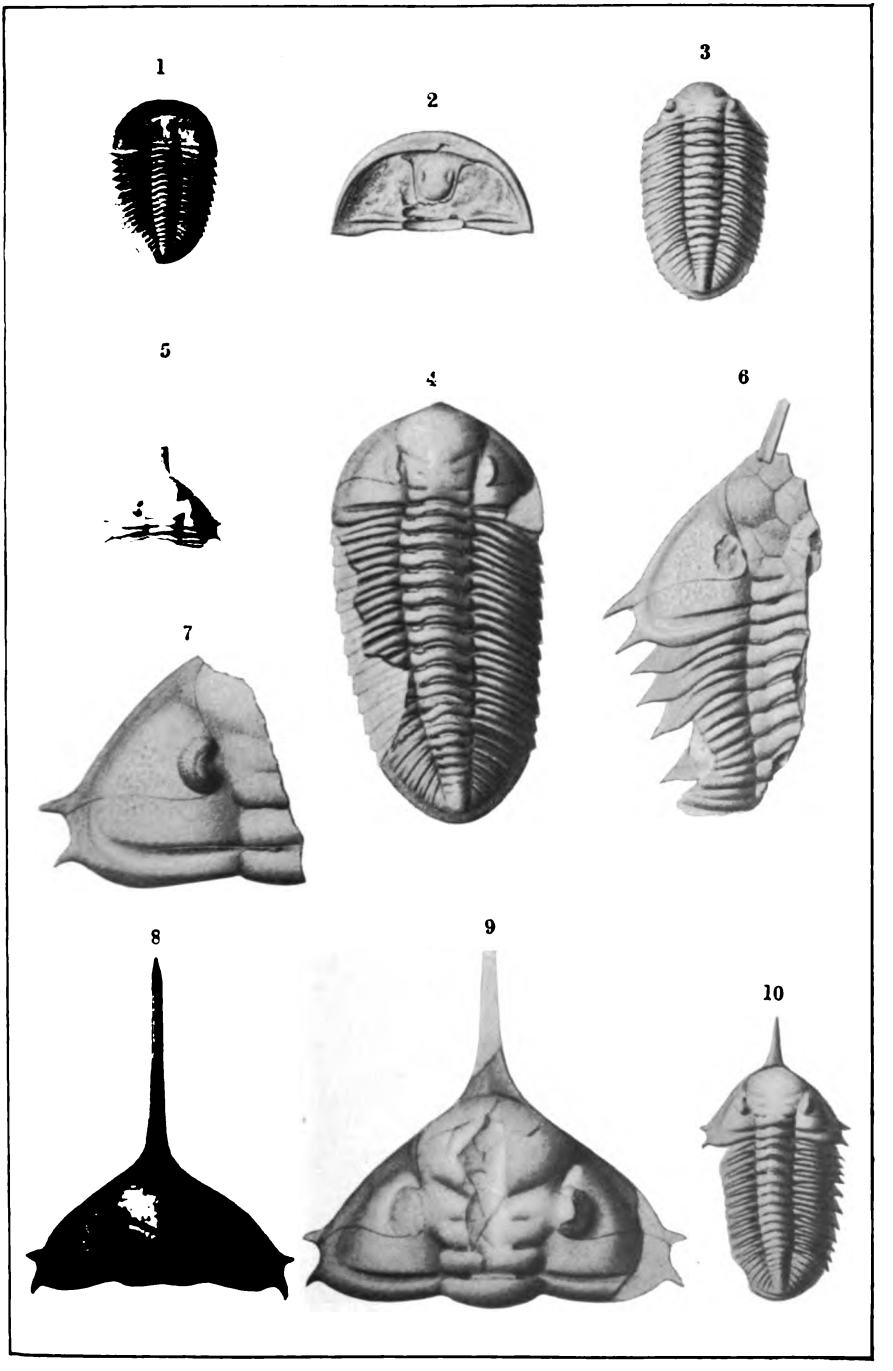
Locality: Ponta Grossa, Brazil

Proboloides pessulus Clarke

Fig. 10 A specimen with all parts conjoined; showing the aspect of the head, its proboscis and sutural spines, the sharply terminated thoracic segments and apparently smooth margined pygidium

Locality: Jaguariahyva, São Paulo, Brazil

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Plate 11

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Conularia ulrichana Clarke

Fig. 1 Enlarged fragment showing nature of ornament
2 A small example. x 2
3 A characteristic example
Locality: Tybagy, São Paulo, Brazil

Conularia africana Salter

Fig. 4 An undistorted fragment
5 A well-developed, nearly entire specimen
Locality: Ponta Grossa, Brazil

Hyolithus subaequalis (Salter)

Fig. 6, 7 The two sides, with operculum in place
Locality: Tybagy, São Paulo, Brazil

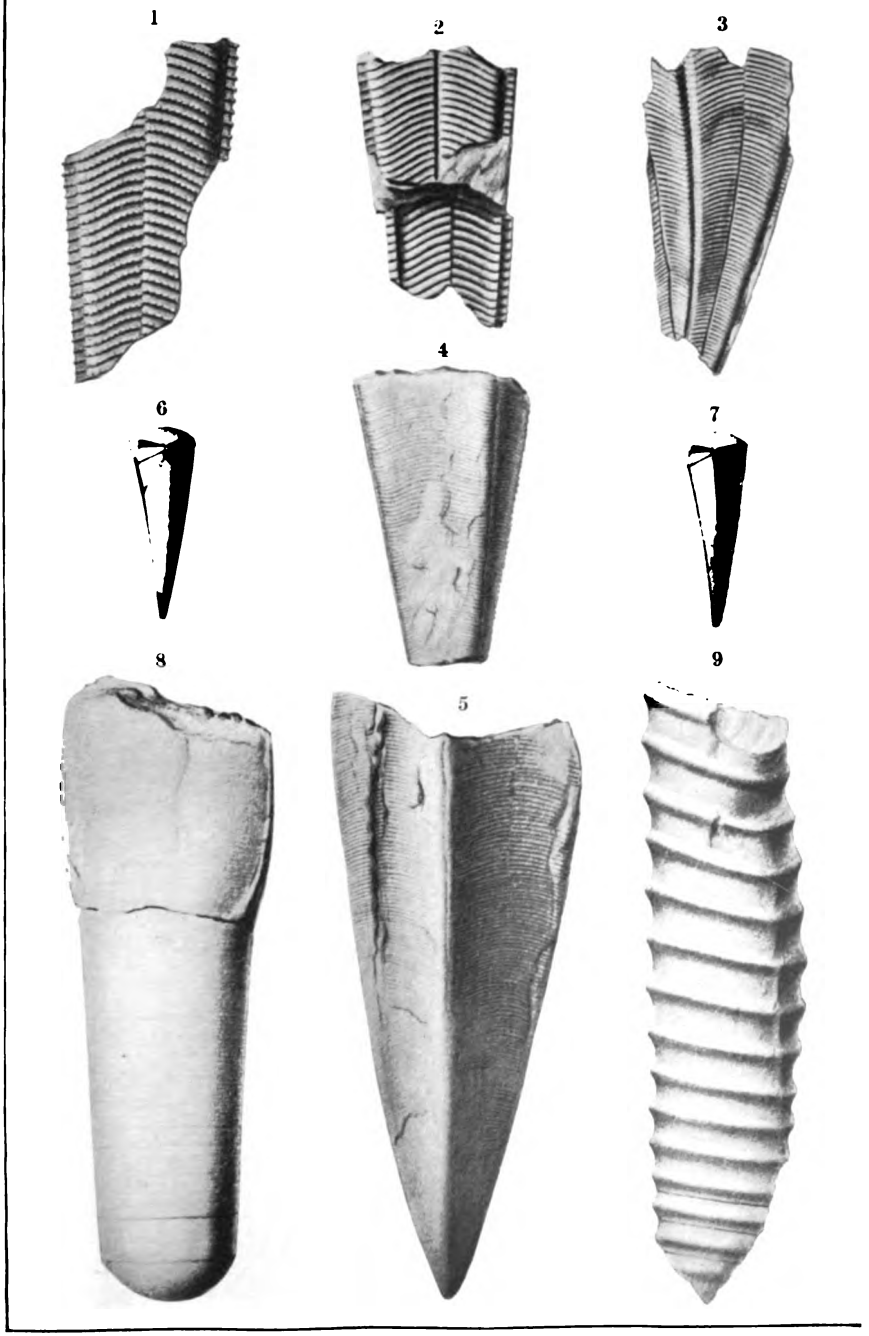
Orthoceras sp. (cf. **gamkaensis** Reed)

Fig. 8 Part of a shell retaining fine concentric surface ornament
Locality: Ponta Grossa, Brazil

Kionoceras zoilus Clarke

Fig. 9 The only example observed
Locality: Ponta Grossa, Brazil

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Plate 12

163

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Tentaculites jaculus Clarke

Fig. 1 A cluster of tubes with characteristic irregularity of annulation. Natural size
Locality: Ponta Grossa, Brazil

Tentaculites crotalinus Salter

Fig. 2 A cluster of tubes. x 3
Locality: Ponta Grossa, Brazil

Tropidocyclus antarcticus Clarke

Fig. 3 Two accidently conjoined individuals
4 Dorsal view showing the character of the striae. x 1½
Locality: Pebble island, West Falkland

Plectonotus (Bucaniella) hapsideus Clarke

Fig. 5 A laterally compressed individual showing the dorsal seam
6, 7 Two other similarly compressed shells
Locality: Ponta Grossa, Brazil

Bellerophon quadrilobatus Salter?

Fig. 8 An internal cast of a trilobed shell which may pertain to this species
Locality: Pebble island, West Falkland

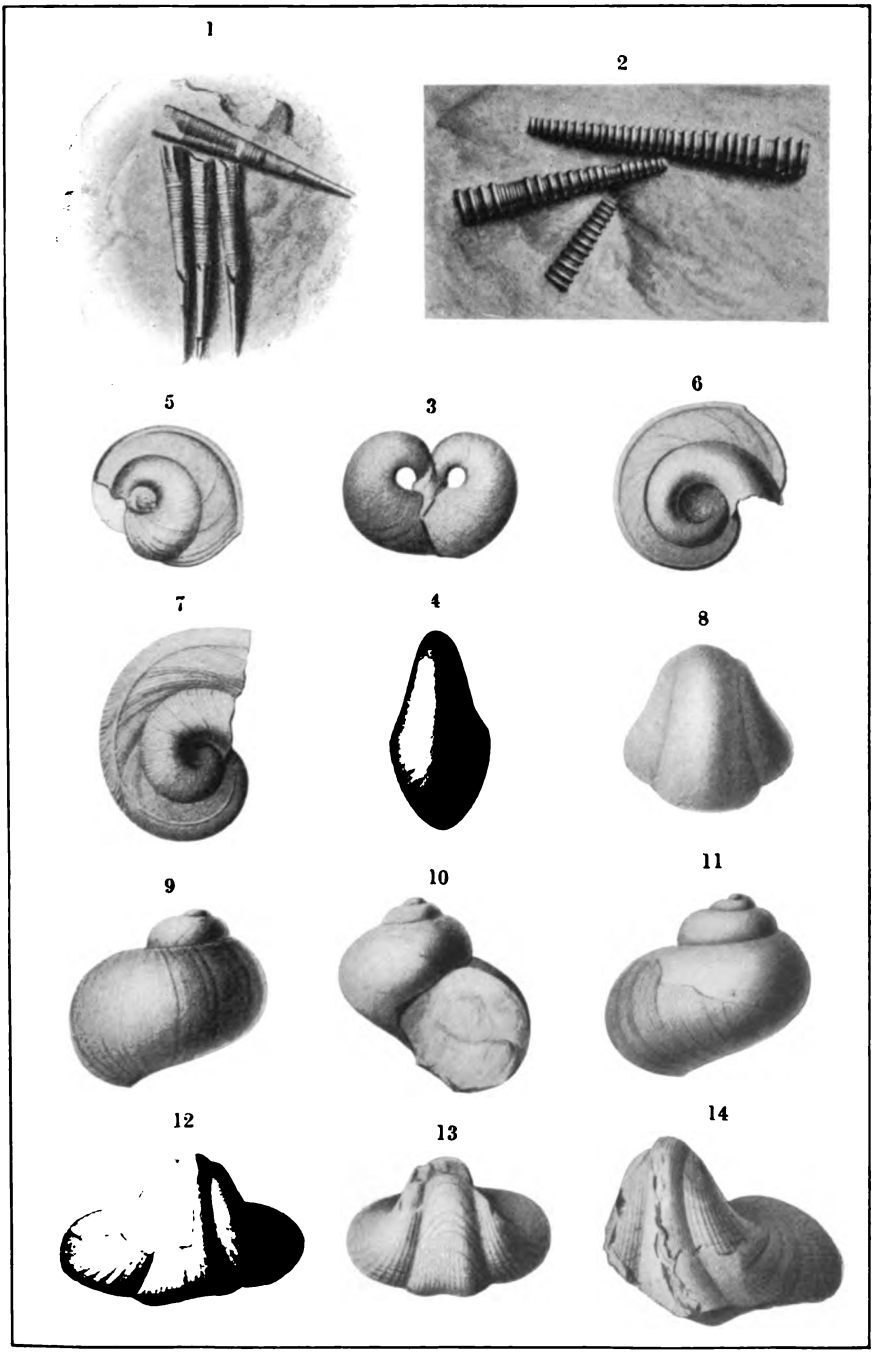
Diaphorostoma allardycei Clarke

Fig. 9, 10, 11 Three views of this species, indicating its form and style of ornament
Locality: Pebble island, West Falkland

Plectonotus (Bucaniella) dereimsi Knod

Fig. 12, 13, 14 Views of more or less complete examples of these shells
Locality: Ponta Grossa, Brazil

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Plate 13

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Ptomatis moreirai Clarke

Fig. 1, 2 Exteriors of two examples
Locality: Ponta Grossa, Brazil

Nuculites reedi Clarke

Fig. 3, 4, 5 Sculpture casts showing the sinuous posterior slopes
Locality: Ponta Grossa, Brazil

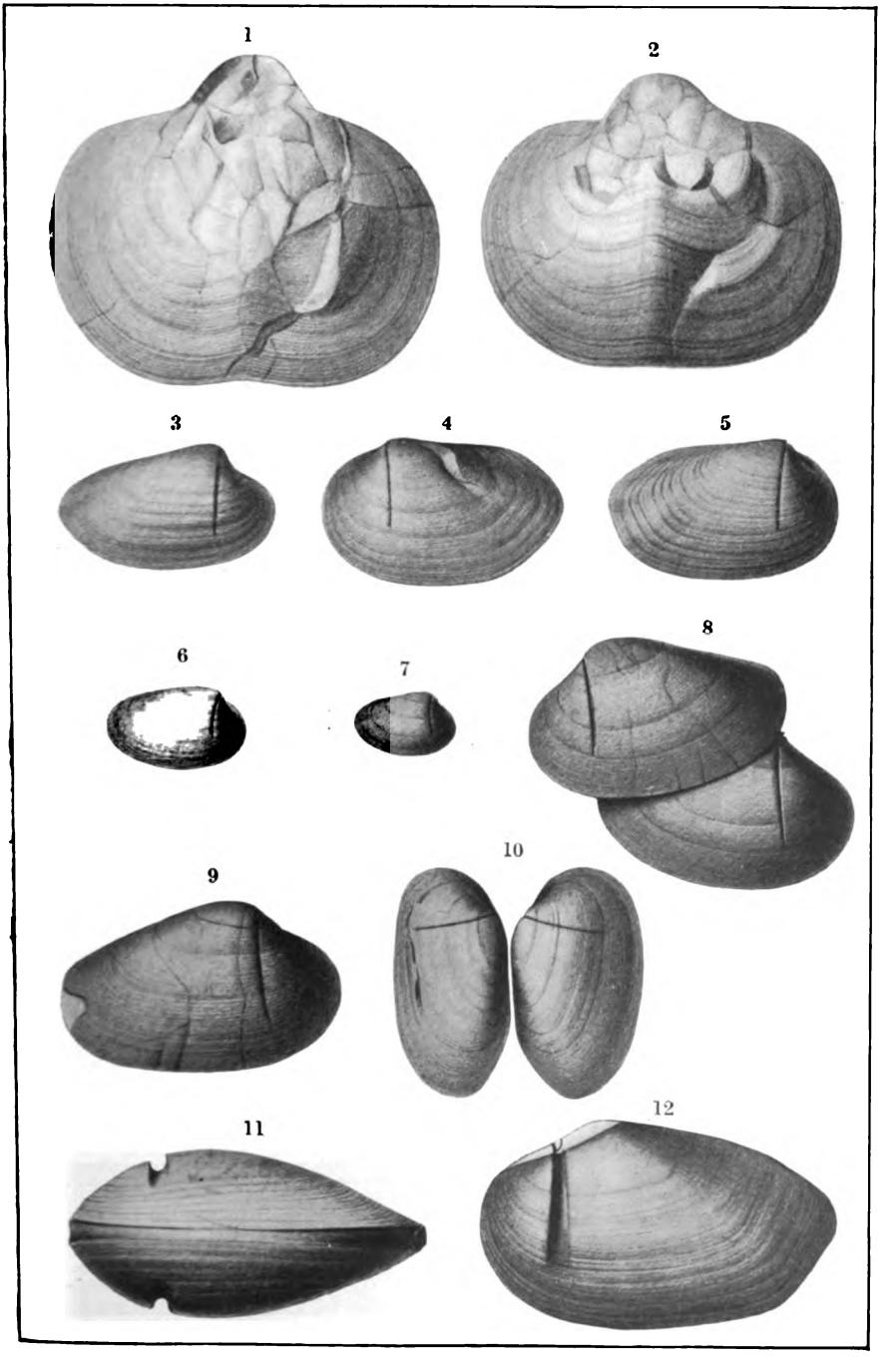
Nuculites parai Clarke

Fig. 6, 7 Sculpture casts from the Upper Devonic black shale, near Ereré, State of Pará, Brazil

Nuculites sharpei Reed

Fig. 8 Sculpture casts of both valves
9, 10 Other examples of the species
Locality: Ponta Grossa, Brazil
11, 12 A large specimen of this type with rather heavy clavicles but with the sinuous posterior slopes
Locality: Pebble island, West Falkland

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Plate 14

167

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Nuculana inornata (Sharpe)

Fig. 1, 2 Opposite sides of the same specimen
3 Another characteristic example
Locality: Ponta Grossa, Brazil

Palaeoneilo rhysa Clarke

Fig. 4, 5 Left and right valves
6 Enlargement of surface ornament of figure 4
Locality: Ponta Grossa, Brazil

Nuculites pacatus Reed

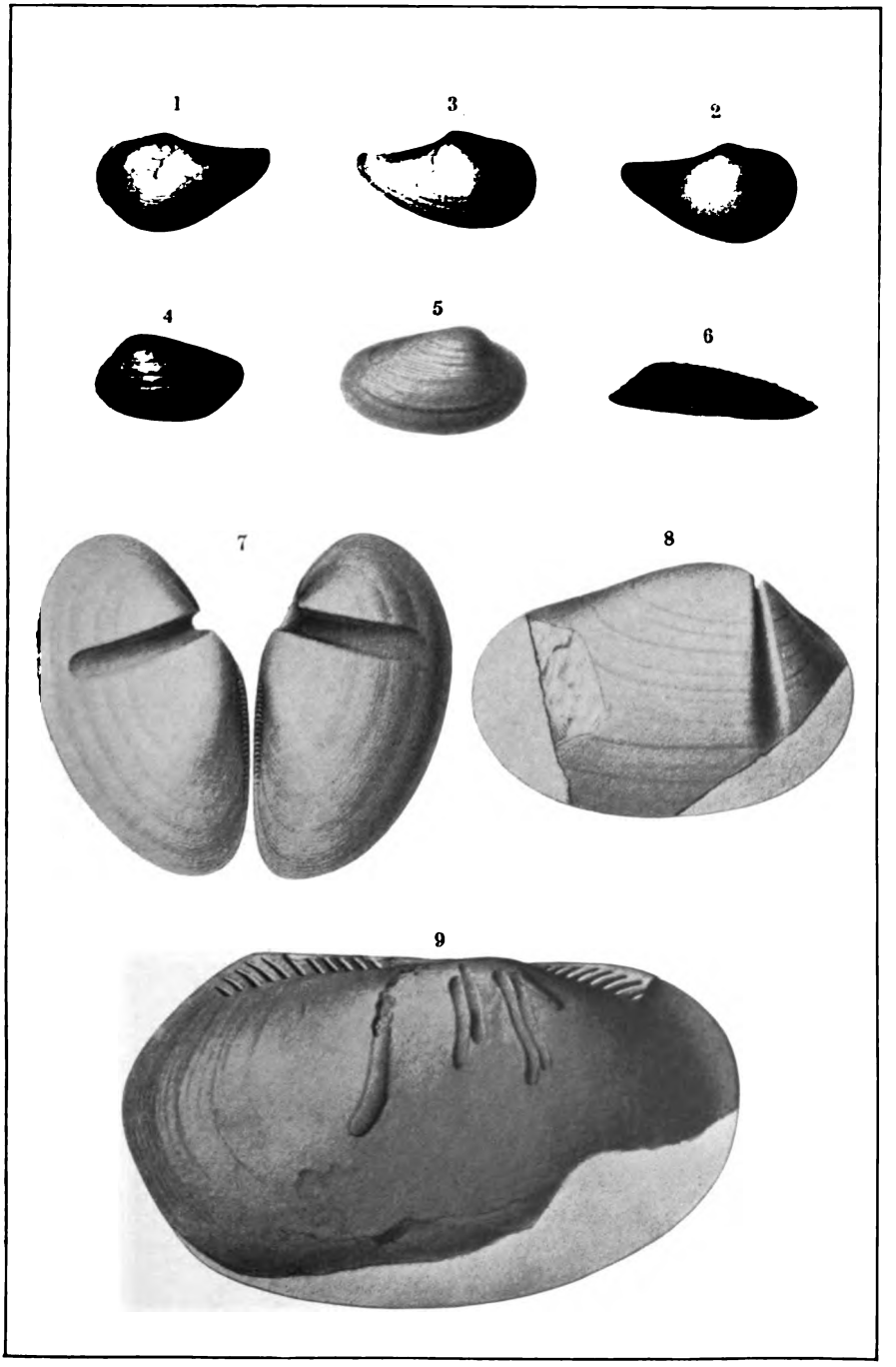
Fig. 7 Interior cast of conjoined valves with strong clavicular ridges
Locality: Jaguariahyva, São Paulo, Brazil
8 Sculpture cast of right valve
Locality: Ponta Grossa, Brazil

Palaeoneilo magnifica Clarke

(See plate 15)

Fig. 9 Internal cast of right valve, showing part of hinge. The borings are those of the sponge Clionolithus priscus (McCoy)
Locality: Ponta Grossa, Brazil

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Plate 15

169

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Palaeoneilo magnifica Clarke

(See plate 14)

Fig. 1 Exterior of left valve
2 Sculpture cast of conjoined valves
Locality: Ponta Grossa, Brazil

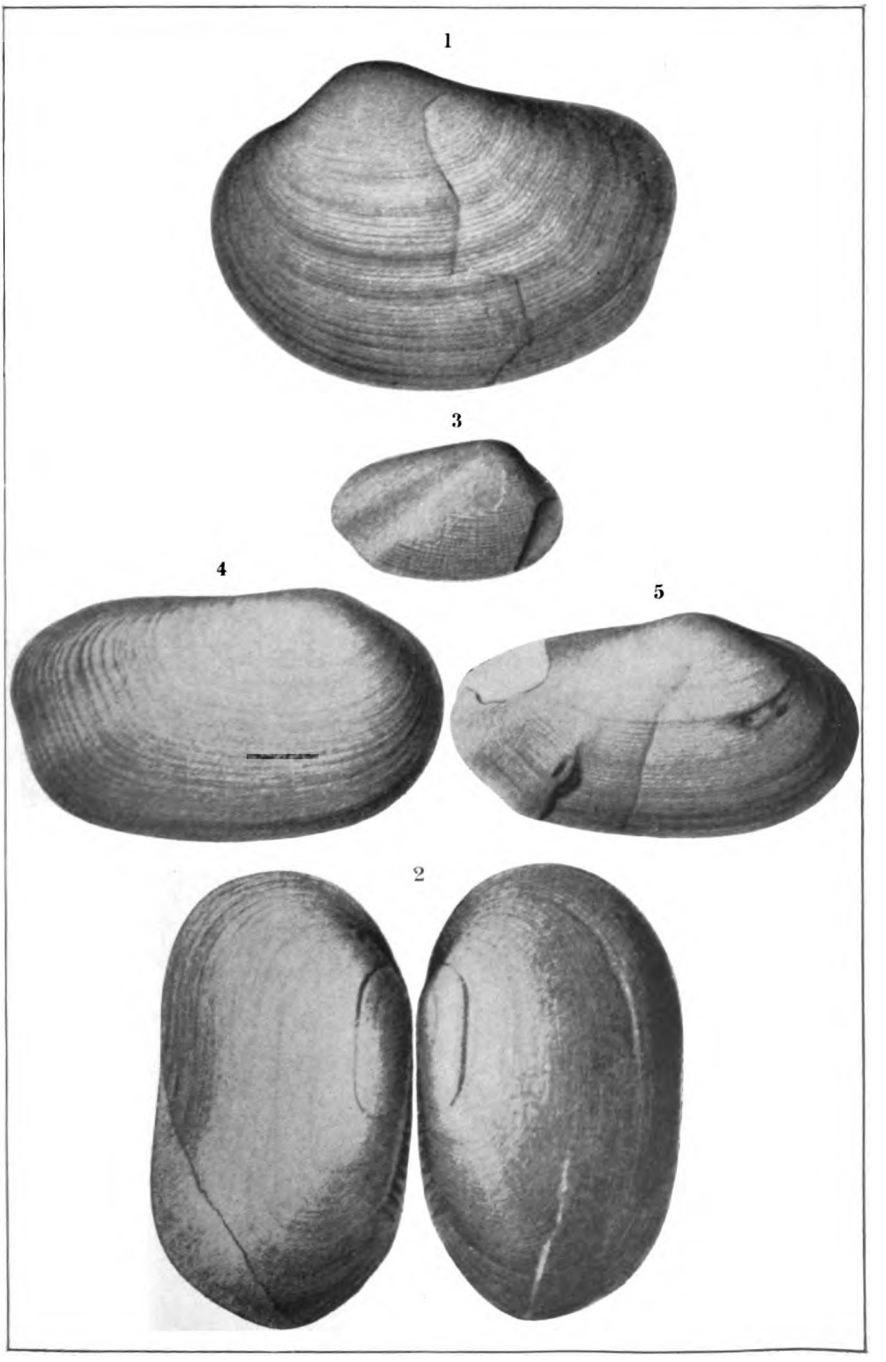
Palaeoneilo sculptilis Clarke

Fig. 3 A weathered right valve showing the radial ornament. From the Upper Devonic shale of Ereré, Pará, associated with Schizobolus truncatus and Nuculites parai

Palaeoneilo sancticrucis Clarke

Fig. 4, 5 Right valves of this species
Locality: Ponta Grossa, Brazil

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Plate 16

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Prothyris (Paraprothyris) knodi Clarke

Fig. 1, 2 Conjoined valves, showing the anterior byssal notch and posterior cardinal ridge

3, 4, 5, 6 Other valves showing in more detail the cardinal characters

7 Enlargement of posterior part of specimen figure 4

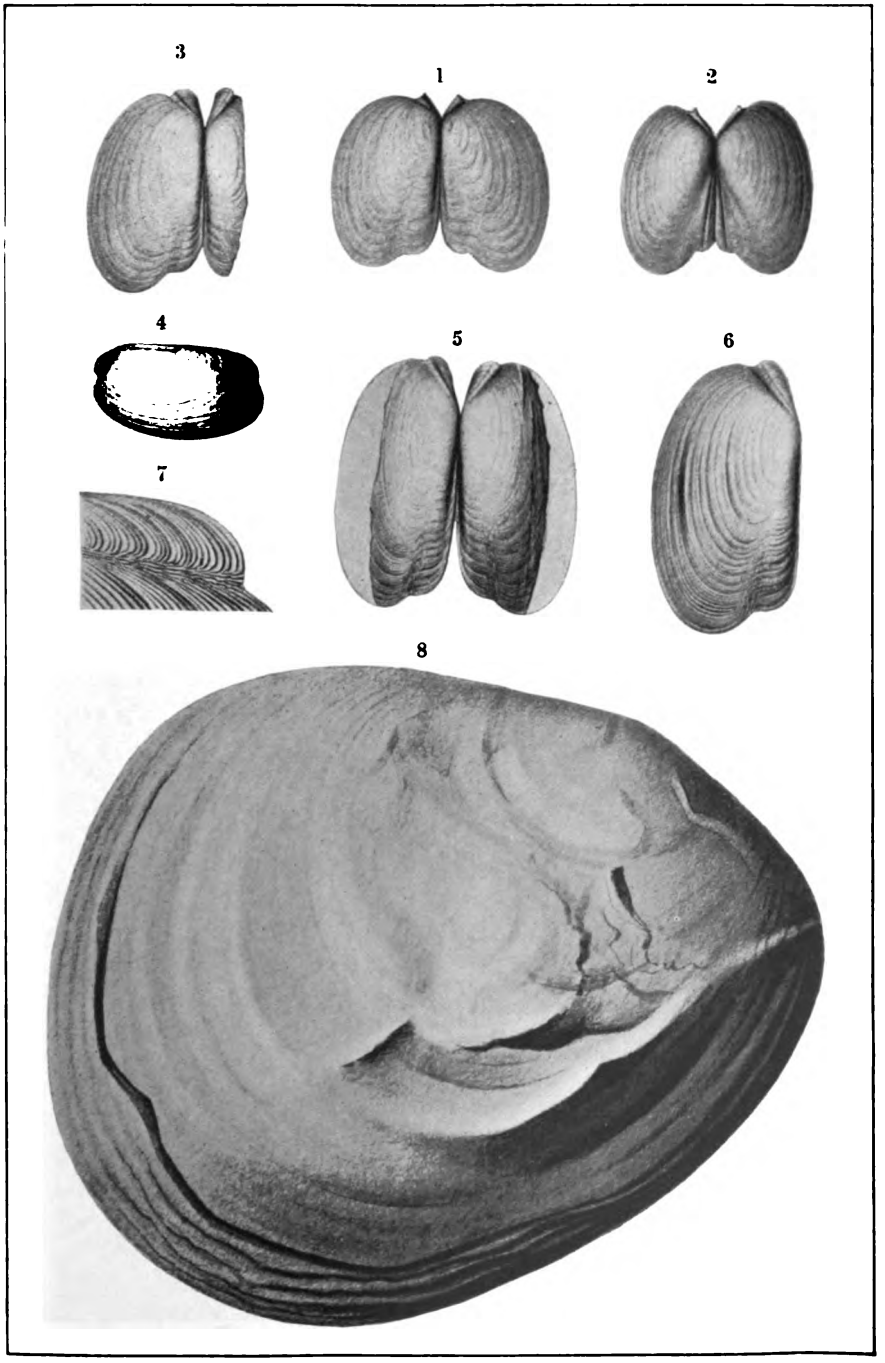
Locality: Ponta Grossa, Brazil

Cardiomorpha ? colossea Clarke

Fig. 8 Sculpture cast of a right valve of medium size

Locality: Ponta Grossa, Brazil

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Plate 17

173

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Pleurodapis multicincta Clarke

Fig. 1, 2 Right and left valves

3 Sculpture casts of conjoined valves with suppression of some of the posterior ridges. The abscission of the umbones by pressure on the hinge-plates is noticeable here, as on the succeeding figures

4 The hinge, showing anterior muscle scars and a broadened platform behind. x 2

5, 6 Right valves, showing considerable divergence in the development of the ridges

Locality: Ponta Grossa, Brazil

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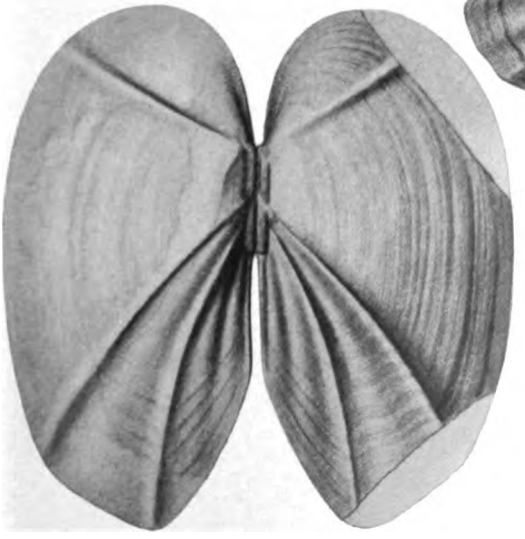
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Plate 18

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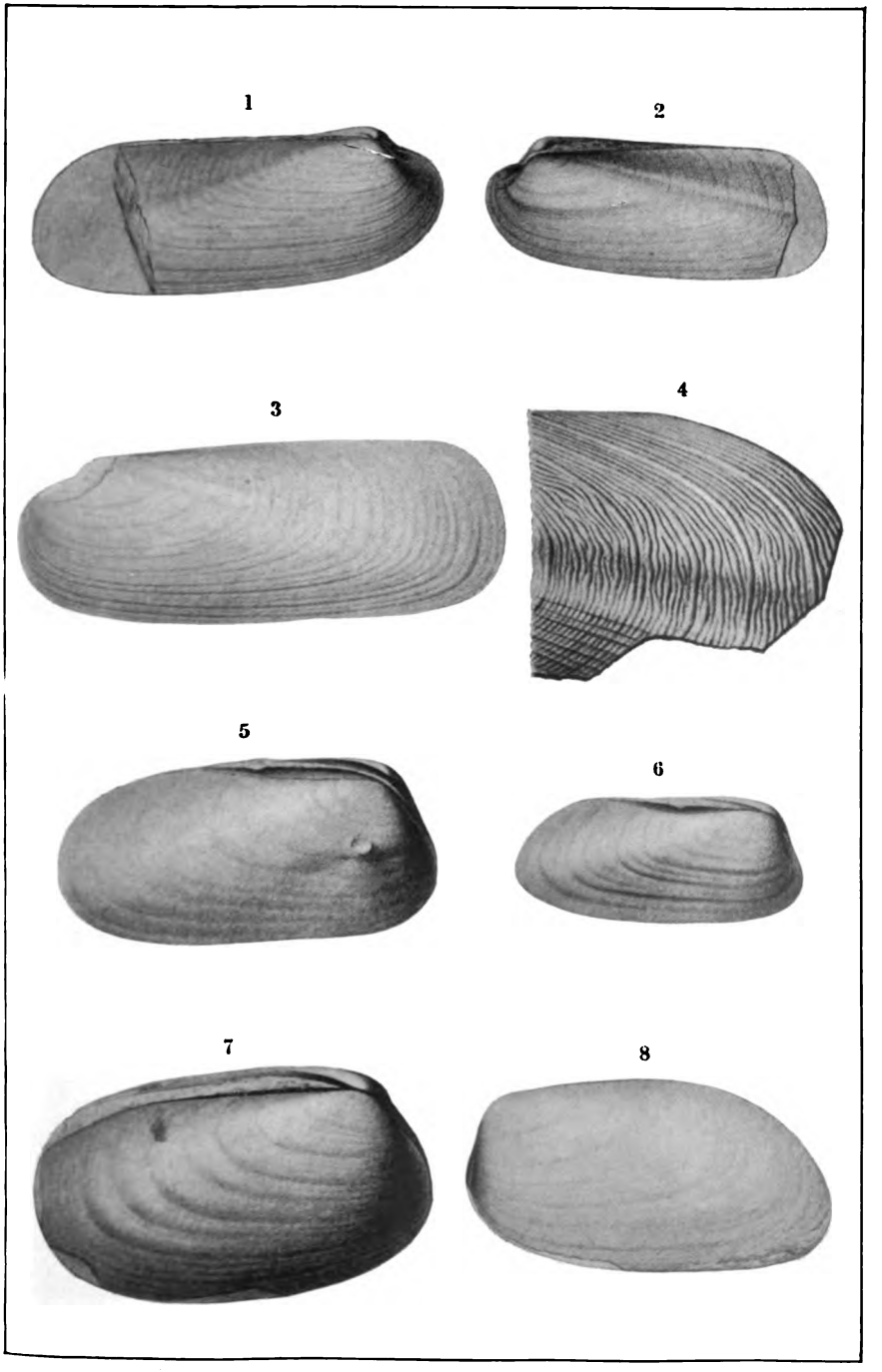
Janeia bokkeveldensis Reed

Fig. 1 Conjoined valves showing the overlapping left
2 The two valves with overlapping right
3 A large left valve
4 Sculpture of posterior part of valve. x 3
Locality: Ponta Grossa, Brazil

Janeia braziliensis Clarke

Fig. 5 Right side of conjoined valves, showing the overlapping left
6 A small specimen
7 Large shell with valves slightly spread
8 Left view of conjoined valves
Locality: Tybagy, São Paulo, Brazil

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Plate 19

177

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Goniophora abbreviata Clarke

Fig. 1, 2 Sculpture casts of right valves
Locality: Jaguariahyva, São Paulo, Brazil

Palaeanatina erebus Clarke

Fig. 3, 4, 5 Conjoined expanded valves
Locality: Ponta Grossa, Brazil

Cypricardella? olivieria Clarke

Fig. 6 Conjoined valves, natural size
7 The left valve, x 3
Locality: Ponta Grossa, Brazil

Sphenotus lagoensis Clarke

Fig. 8 Expanded conjoined valves with the crescence ridge somewhat intensified by compression
9 A right valve
Locality: Lago, state of São Paulo, Brazil

Leptodomus capricornus Clarke

Fig. 10 A right valve
11 A left valve
12 Enlargement of posterior slope
Locality: Ponta Grossa, Brazil

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Plate 20

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Modiomorpha austronotica Clarke

Fig. 1, 2 Sculpture casts of right and left valves
3 A right valve
4 Expanded valves in juxtaposition
Locality: Ponta Grossa, Brazil

Modiomorpha ? scaphula Clarke

Fig. 5, 6 Right and left sculpture valves
Localities: Ponta Grossa and Tybagy, Brazil

Phthonia ? epops Clarke

Fig. 7 Right valve showing surface characters
8 Enlargement of surface on posterior slope
Locality: Jaguariahyva, Brazil

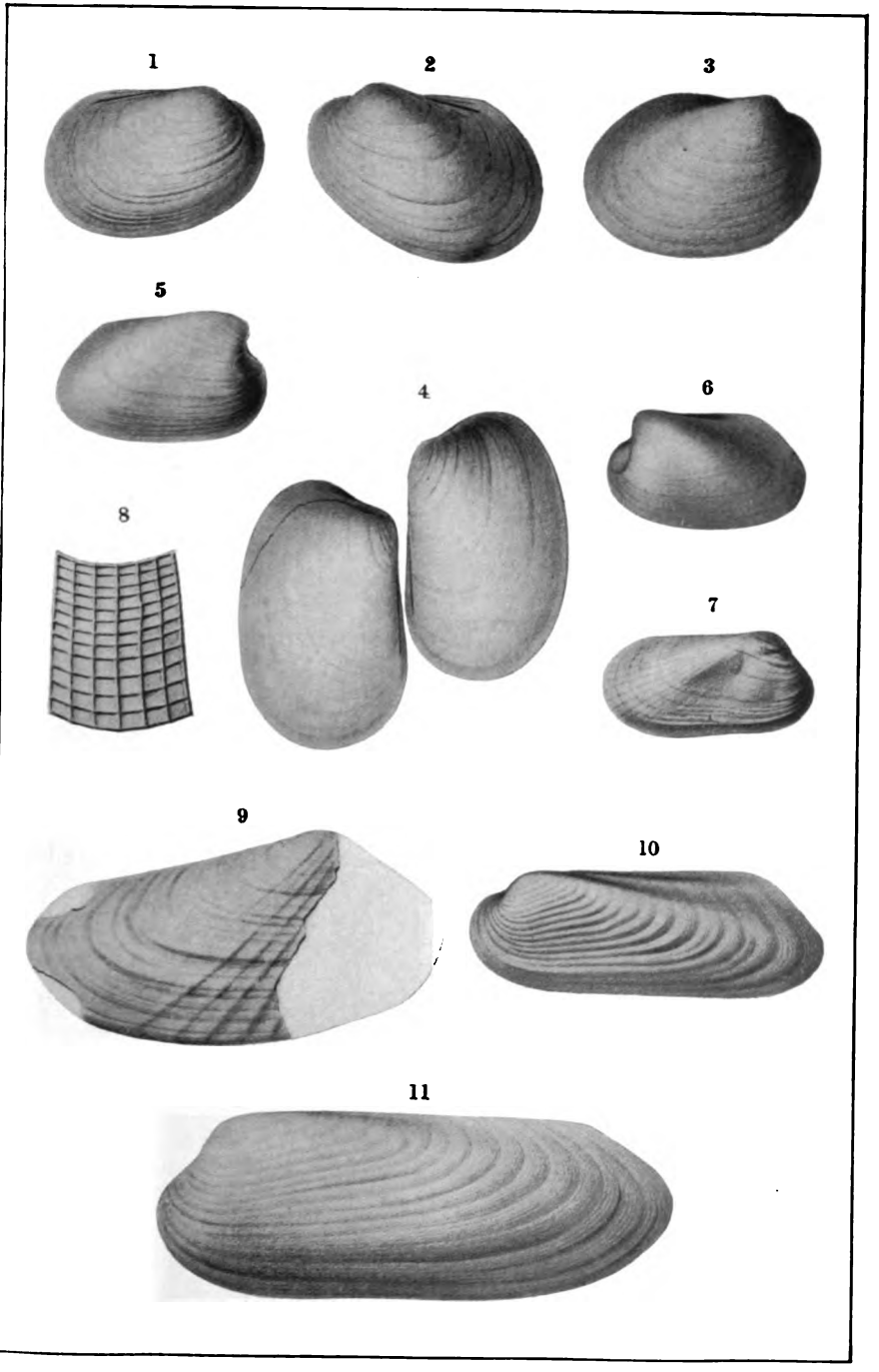
Pholadella cf radiata Hall

Fig. 9 Fragment of a large specimen provisionally referred to this species
Locality: Tybagy, Brazil

Leptodomus ulrichi Clarke

Fig. 10, 11 Left valves of this species
Locality: Ponta Grossa, Brazil

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Plate 21

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Derbyina smithi (Derby)

Fig. 1, 2 Copies of Derby's figures of the brachial apparatus
3 Ventral side of an internal cast. x 2
4, 5, 6 Ventral profile and dorsal views of an internal cast. x 2
Locality: Ponta Grossa, Brazil

Paranaia margarida (Derby)

Fig. 7, 8 Derby's figures of the brachial apparatus
Locality: Sant'Ana de Chapada, Mato Grosso, Brazil

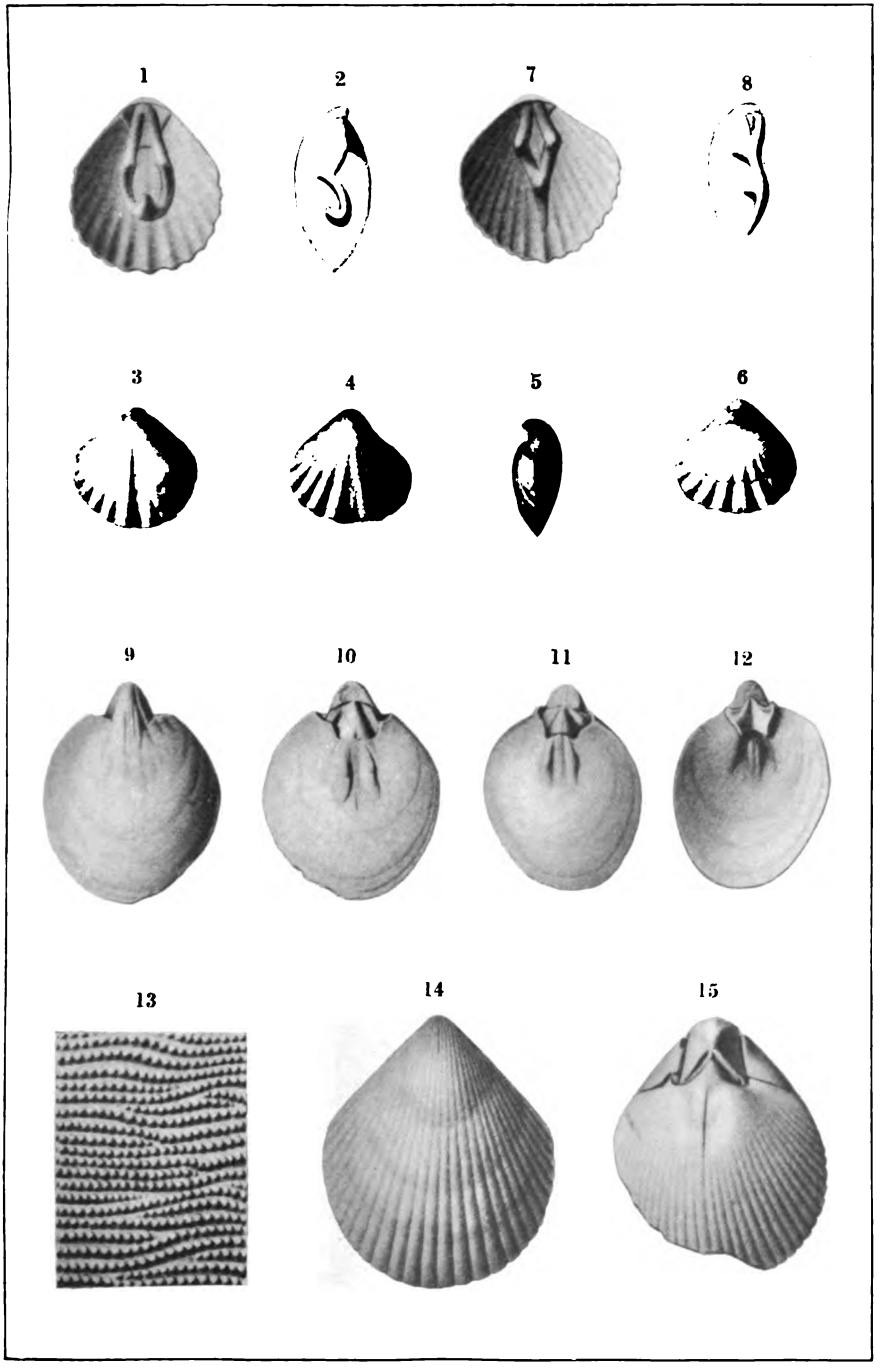
Cryptonella ? baini (Sharpe)

Fig. 9 Cast of ventral valve
10, 11 Dorsal views of internal casts
12 Dorsal valve with hinge plate
13 Enlargement of the surface of an inside cast, showing the filling of the shell punctures
Locality: Tybagy, São Paulo, Brazil

Rensselaeria falklandica Clarke

Fig. 14 Internal cast of ventral valve
15 Dorsal view of an internal cast
Locality: Port Howard, East Falkland

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Plate 22

183

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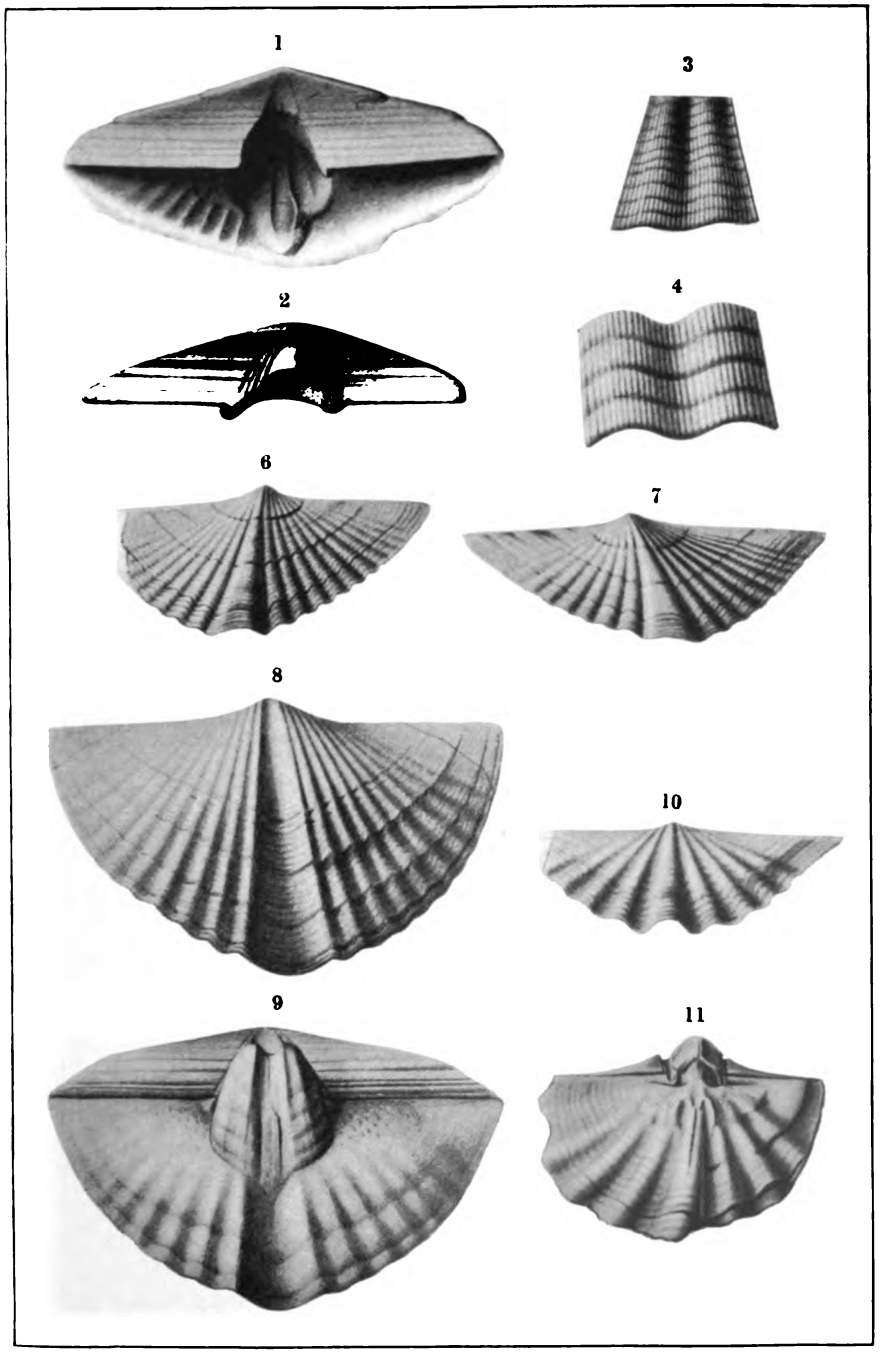
Spirifer antarcticus Morris and Sharpe

Fig. 1 Ventral cardinal view of a shell without deltidium, but with apical callus
2 Similar view of an old shell with deltidium
Locality: Port Louis, East Falkland
3 Enlargement of surface
Locality: Jaguariahyva, Brazil
4 Enlargement of surface
6, 7 Dorsal valves
8 Exterior of a large individual
9 Internal cast of the same valve
Locality: Port Louis, East Falkland

Spirifer hawkinsi Morris and Sharpe

Fig. 10 Dorsal valve
11 Dorsal side of an internal cast
Locality: Port Louis, East Falkland

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Plate 23

185

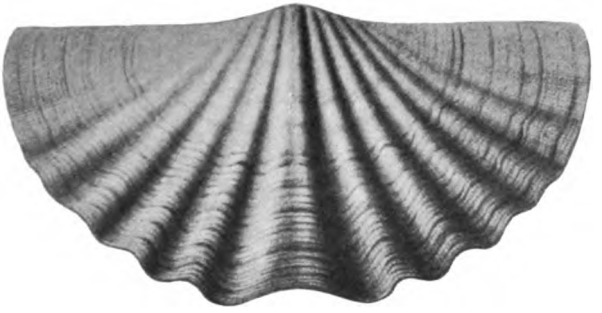
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Spirifer kayserianus Clarke

Fig. 1 A well-preserved dorsal valve, with the characteristic mature sculpture
2 Sculpture cast of the ventral valve
3, 4 Dorsal valves of adult shells
Locality: Ponta Grossa, Brazil

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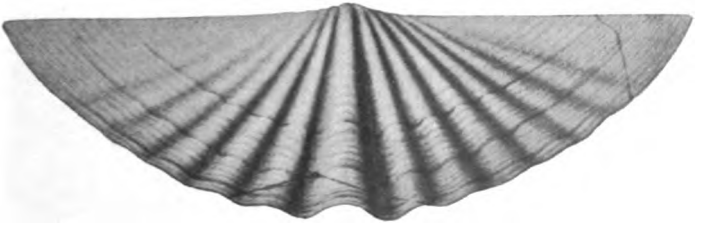
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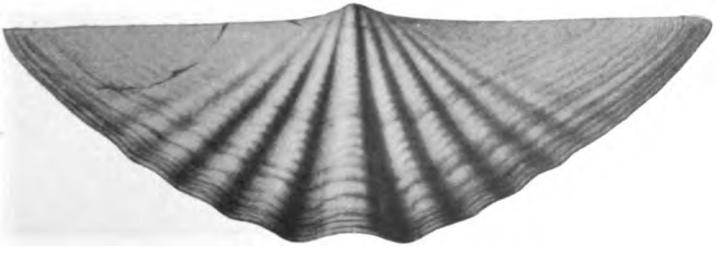
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Plate 24

187

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Spirifer iheringi Kayser

(See plate 25)

Fig. 1, 2 Dorsal aspects of internal casts of young shells
3 Front view of conjoined valves of a mature individual
4 Enlargement of surface in a mature valve
5 A mature dorsal valve
6 Dorsal view of a characteristic internal cast
7, 8 The cardinal process in different stages of development
Locality: Tybagy, state of São Paulo, Brazil

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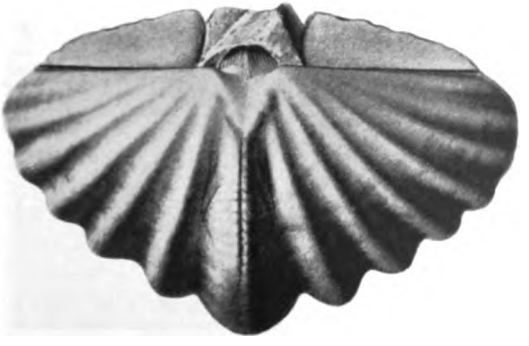
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Plate 25

189

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Spirifer lauro-sodreanus Katzer

Fig. 1, 2 Two views of the type specimen
Locality: Maecurú sandstone, Rio Maecurú, Pará

Spirifer iheringi Kayser

(See plate 24)

Fig. 3 Ventral view of large internal cast
4 View of large ventral cast
Locality: Tybagy, Brazil

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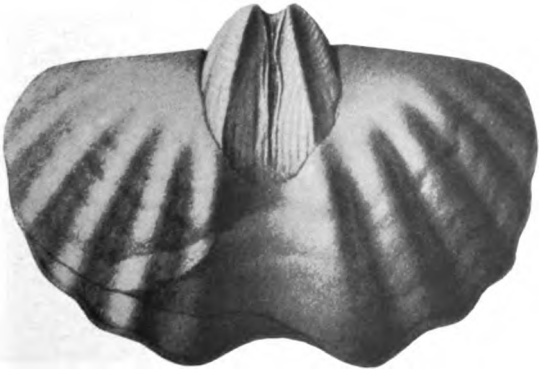
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Plate 26

191

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Plate 26

191

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Spirifer katzeri Clarke

Fig 1, 2 View of a dorsal valve, showing the elevation of the fold and the number of ribs
Locality: Maecurú sandstone, Rio Maecurú, Pará

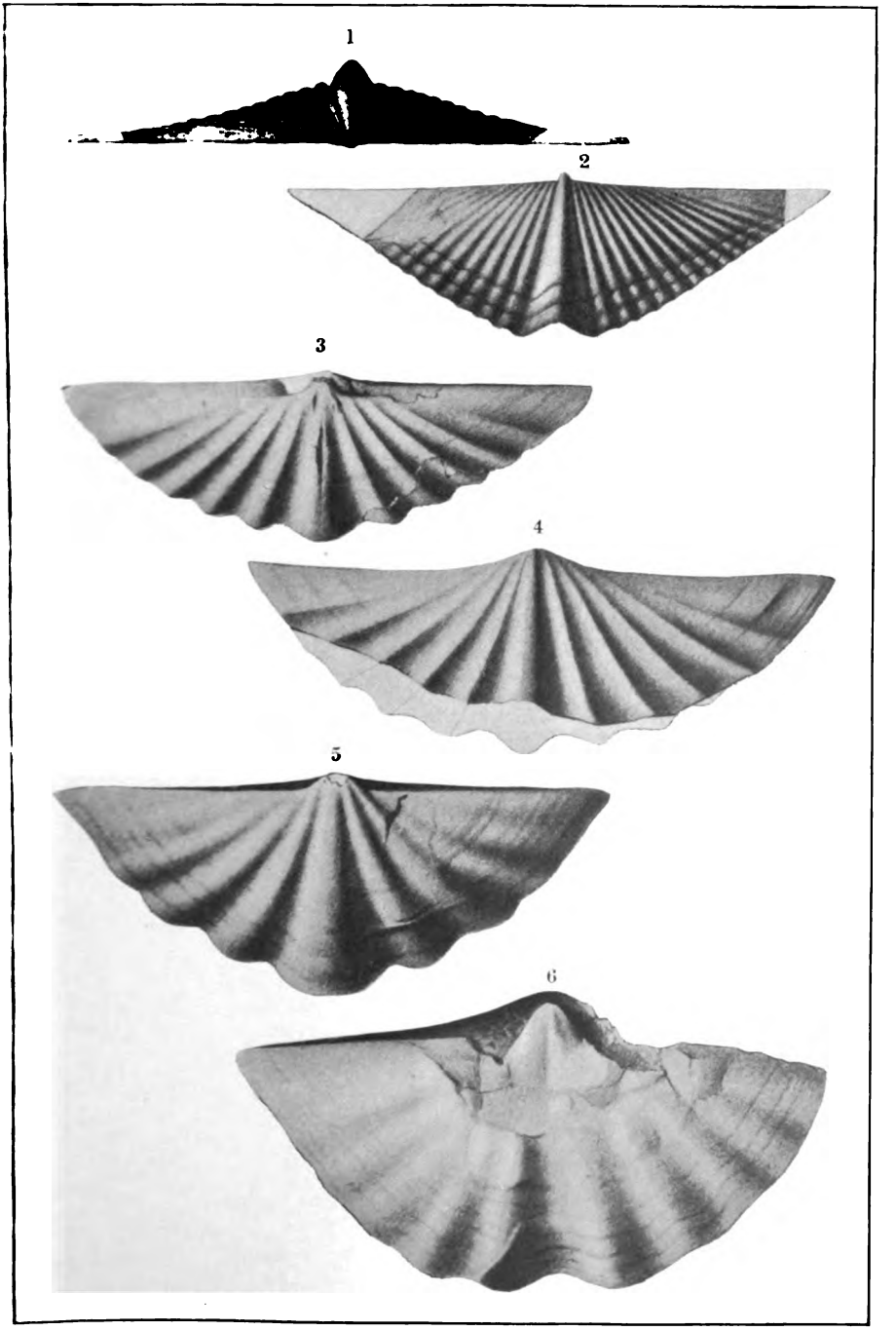
Spirifer contrarius Clarke

Fig. 3, 4 Casts of dorsal valves showing sharp, distinct ribs and broadly concave interspaces
Locality: Ponta Grossa, Brazil

Spirifer parana Clarke

Fig. 5 A dorsal valve with few broadly rounded ribs
6 A crushed specimen with similar characters
Locality: Ponta Grossa, Brazil

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Plate 27

193

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Derbyina whitiorum Clarke

Fig. 1, 2 Exterior and internal cast of ventral and dorsal valves
3 Enlargement of ventral hinge
4 A dorsal valve
Locality: Ponta Grossa, Brazil

Leptocoelia flabellites (Conrad)

Fig. 5 Exterior of an average adult specimen
6 A dorsal valve
7 Internal cast of large ventral valve
Locality: Ponta Grossa, Brazil
8 Internal cast of dorsal valve
Locality: Jaguariahyva, Brazil
9 Dorsal cast
Locality: Cold Bokkeveld, Cape Colony

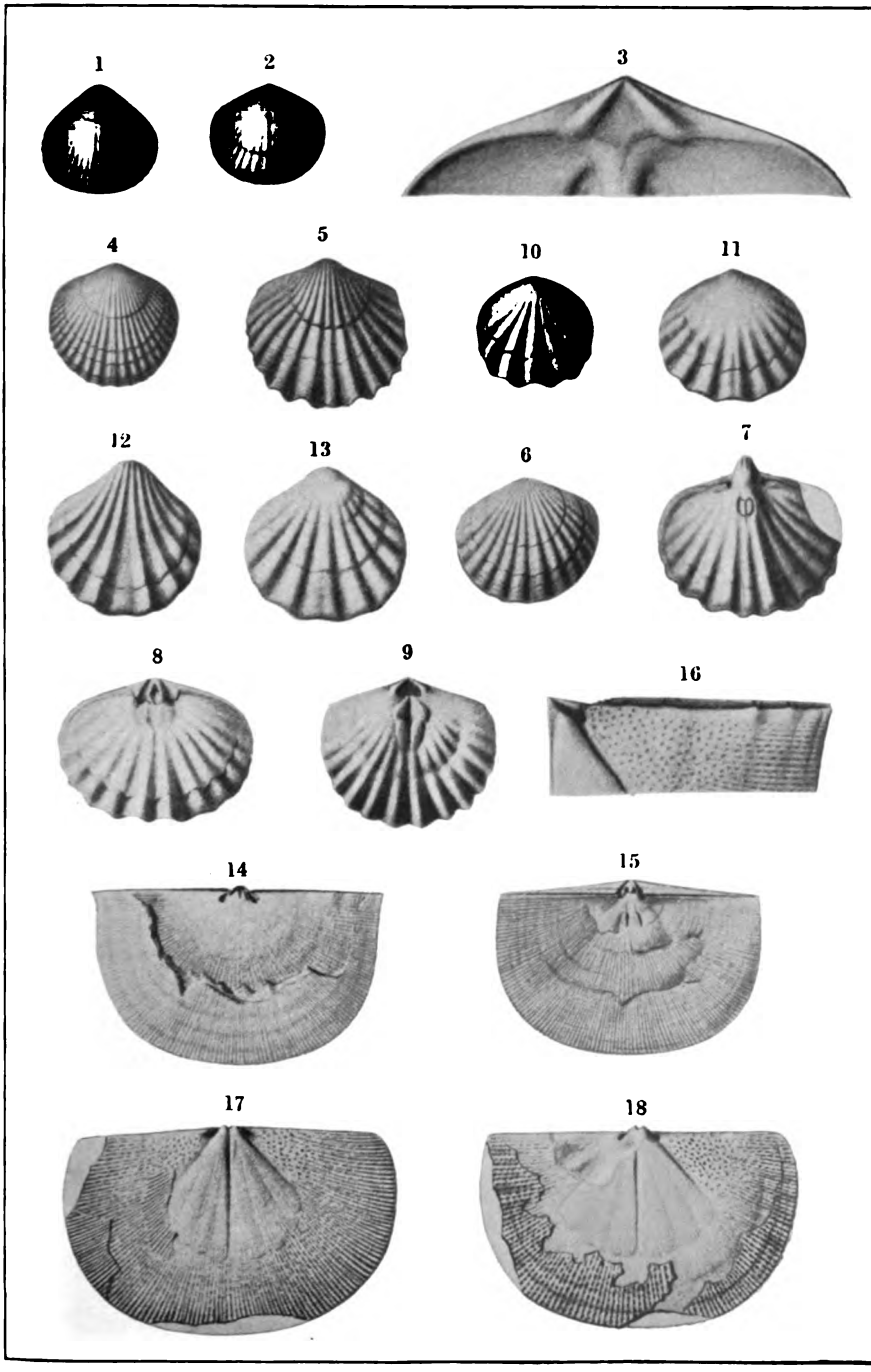
Coelospira ? colona Clarke

Fig. 10, 11 Ventral valves. x 2
12, 13 Ventral and dorsal views. x 2
Locality: Ponta Grossa, Brazil

Leptostrophia ?? mesembria Clarke

Fig. 14 Exterior of ventral with internal cast of dorsal valve
15 Sculpture cast showing dorsal aspect
Locality: Fox bay, West Falkland
16 Enlargement of hinge structure showing incipient denticles or spinules on cardinal line
17 Internal cast of ventral valve
Locality: Ponta Grossa, Brazil
18 Internal ventral cast
Locality: Jaguariahyva, Brazil

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Plate 28

195

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Leptostrophia concinna (Morris & Sharpe)

Fig. 1 Internal cast of ventral valve
2 Interior of dorsal valve
3 Internal cast of ventral valve
Localities: Port Howard, West Falkland, and Port Louis, East Falkland

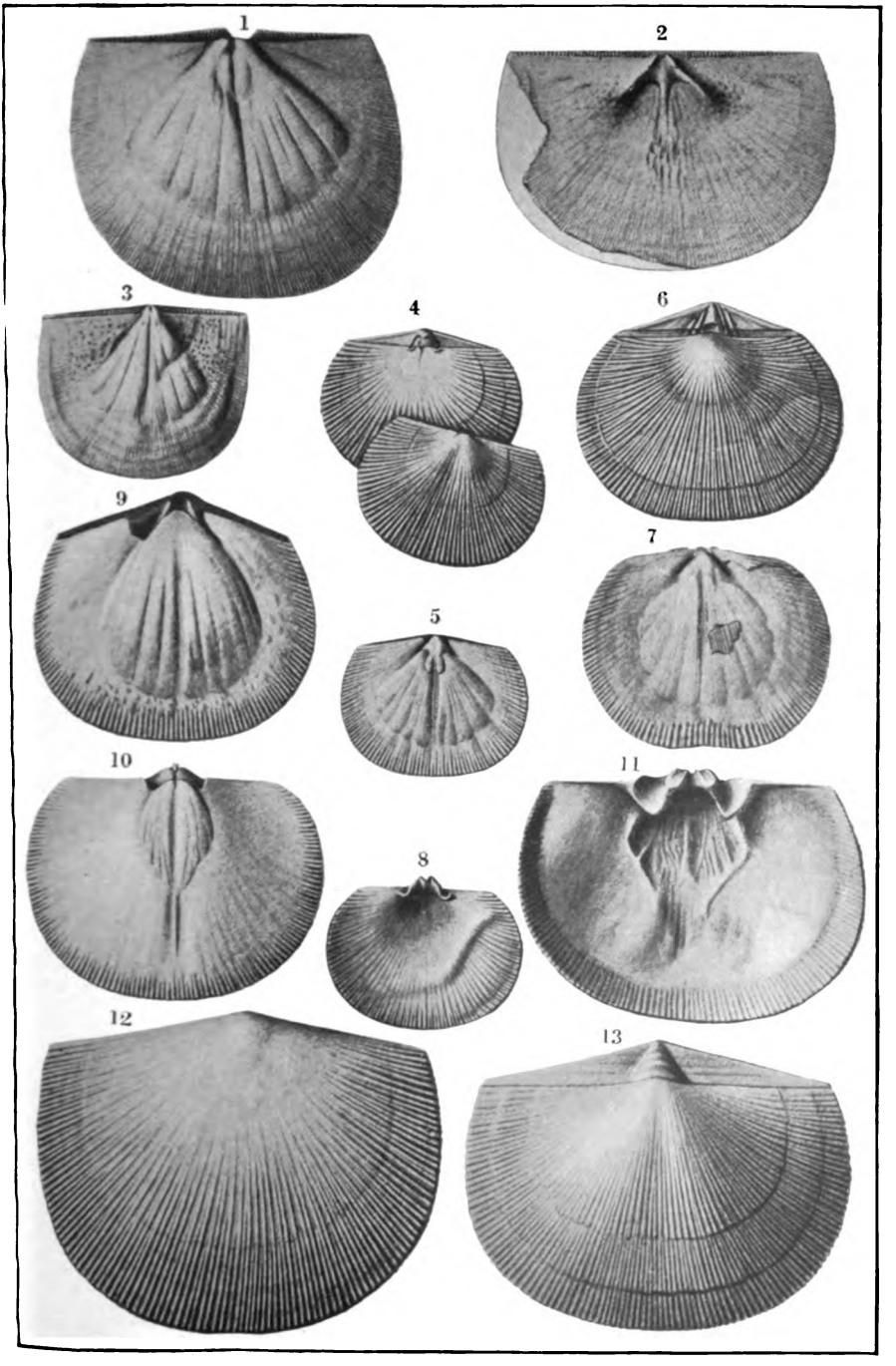
Schuchertella agassizi (Hartt & Rathbun)

Fig. 4 Two characteristic examples showing dorsal aspect only
5 Interior of ventral valve
6 A large and rather short hinged example
7 Internal cast of ventral valve
8 Interior of dorsal valve
Locality: Ponta Grossa, Brazil

Schuchertella sulivani (Morris & Sharpe)

Fig. 9 Internal cast of a ventral valve
Locality: Fox bay, West Falkland
10 Internal cast of dorsal valve
11 Interior of dorsal valve
12 Exterior of ventral valve
13 Dorsal aspect of conjoined valves
Locality: Ponta Grossa, Brazil

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Plate 29

197

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Chonetes falklandicus Morris & Sharpe

Fig. 1–8 A series of views of this species showing its somewhat variable characters. Figures 1, 2, 3 are from Port Louis, East Falkland; figures 5, 7 from Ponta Grossa; figure 6 is the variety r u g o s a from Ponta Grossa; figures 4, 8 from Jaguariahyva

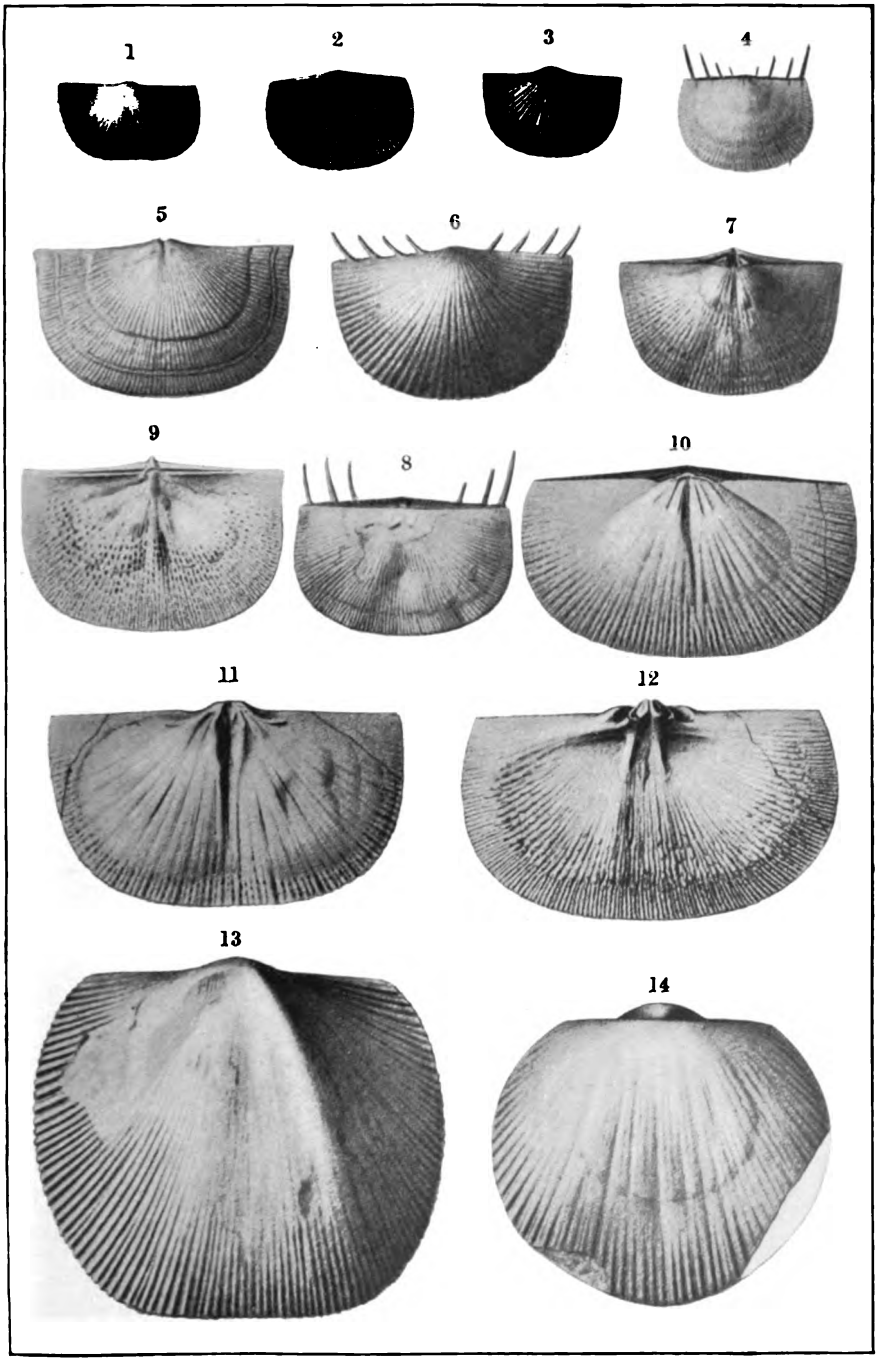
Chonetes skottsbergi Clarke

Fig. 9 Dorsal aspect of internal cast
10, 11 Internal casts of ventral valve
12 Interior of dorsal valve
Locality: Port Salvador, West Falkland

Schuchertella sancticrucis Clarke

Fig. 13, 14 Internal casts of dorsal and ventral valves
Locality: Santa Cruz, state of São Paulo, Brazil

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Chonetes falklandicus Morris & Sharpe

Fig. 1–8 A series of views of this species showing its
variable characters. Figures 1, 2, 3 are f
Lewis, East Falkland; figures 5, 7 from Pont
figure 6 is the variety rugosa from Pont
figures 4, 8 from Jaguarahyva

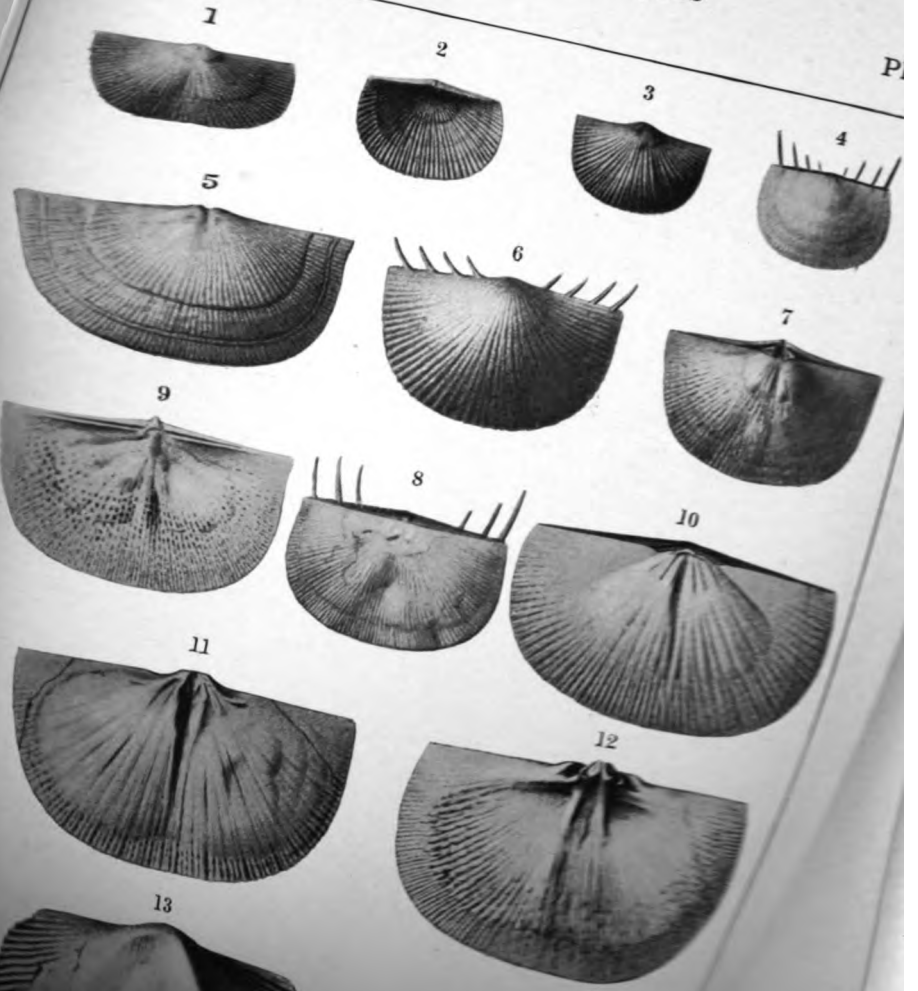
Chonetes skottsbergi Clarke

Fig. 9 Dorsal aspect of internal cast
10, 11 Internal casts of ventral valve
12 Interior of dorsal valve
Locality: Port Salvador, West Falkland

Schuchertella sanctacrucis Clarke

Fig. 13, 14 Internal casts of dorsal and ventral valves
Locality: Santa Cruz, state of São Paulo, Brazi

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Plate 30

199

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Chonetes hallei Clarke

Fig. 1 Internal cast of conjoined valves
Locality: Spring Point, Falkland islands

Schizobolus truncatus Hall

Fig. 2, 3 Brachial and pedicle valves. x 3
Locality: Upper Devonic black shale of Ereré, Pará

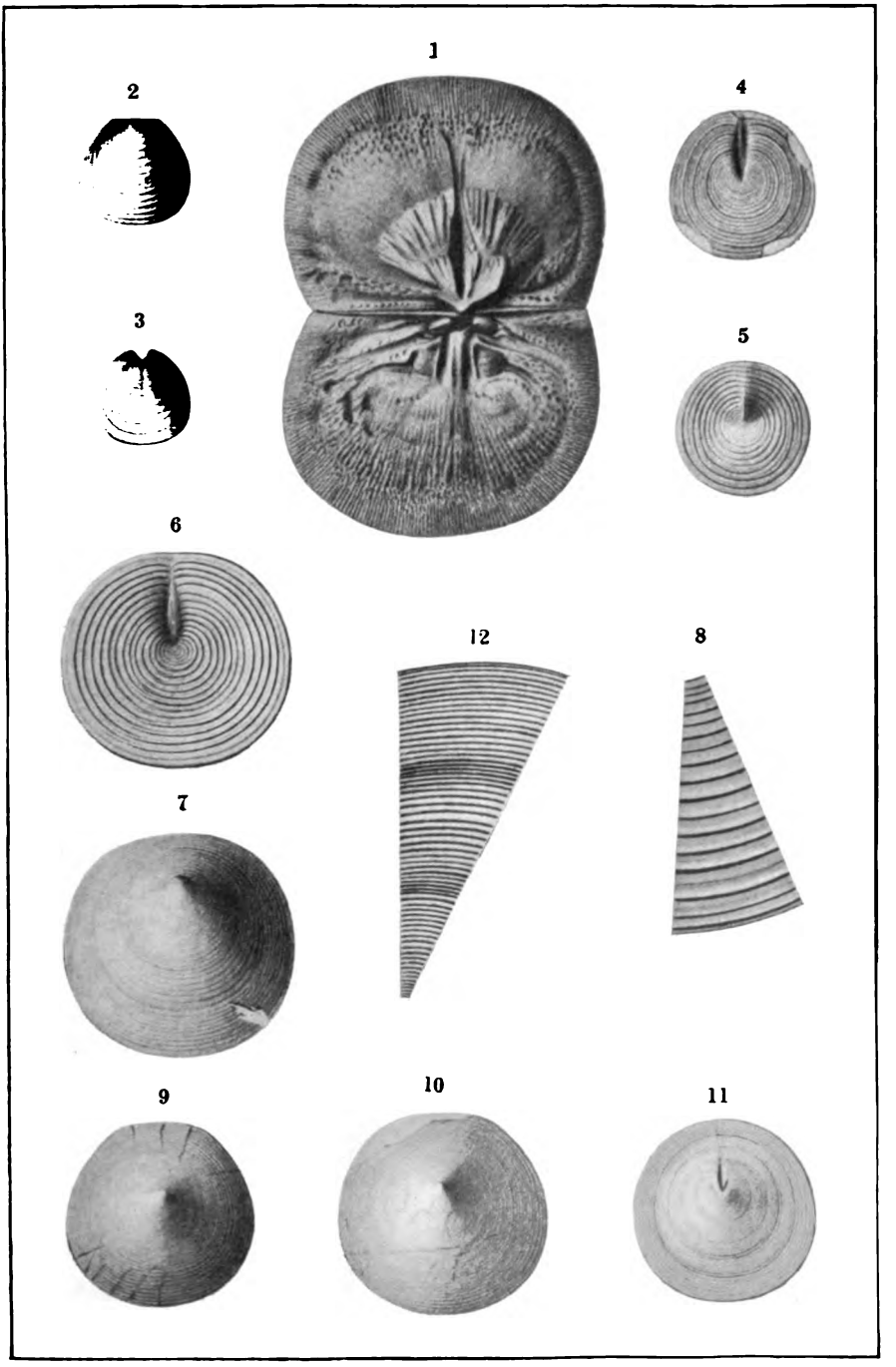
Orbiculoidea baini (Sharpe)

Fig. 4, 5 Pedicle valves, exterior and interior surfaces
6, 7 Pedicle and brachial valves. x 2
8 Enlargement of surface of pedicle valve
Locality: Ponta Grossa, Brazil

Orbiculoidea bodenbenderi Clarke

Fig. 9, 10 Brachial valves
11 Pedicle valve
12 Enlargement of surface of pedicle valve
Locality: Ponta Grossa, Brazil

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Plate 31

201

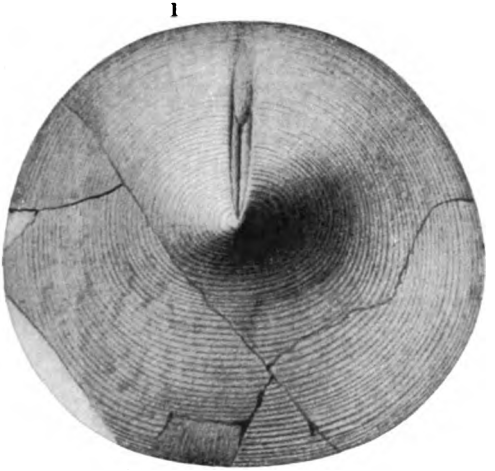
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Orbiculoidea collis Clarke

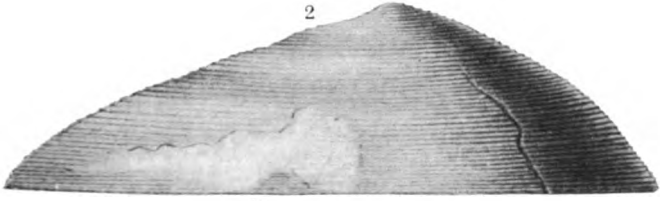
Fig. 1 Exterior of pedicle valve
2, 3 A brachial valve and its profile
Locality: Ponta Grossa, Brazil

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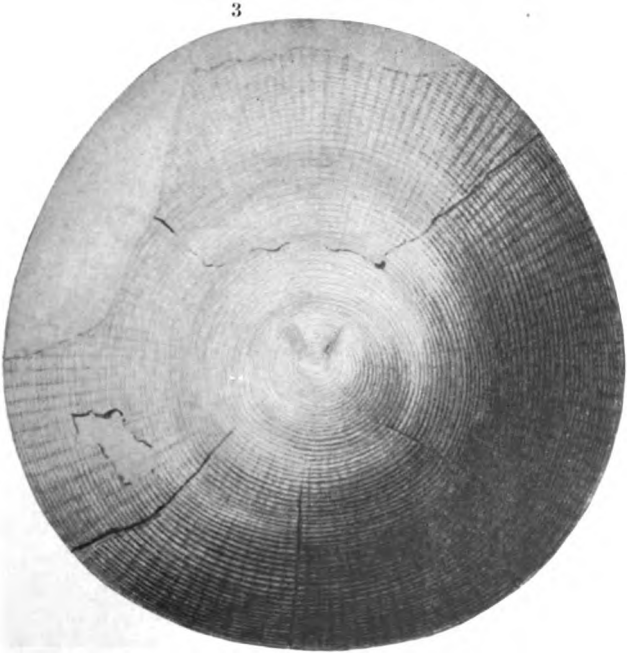
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Plate 32

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Lingula scalprum Clarke

Fig. 1, 2 Dorsal and ventral valves
Locality: Ponta Grossa, Brazil

Lingula lepta Clarke

Fig. 3, 4 Valves showing outline and muscular scars
Locality: Ponta Grossa, Brazil

Lingula keideli Clarke

Fig. 5, 6 Ventral and dorsal valves
Locality: Ponta Grossa, Brazil

Lingula lamella Clarke

Fig. 7 Conjoined valves
8 Dorsal valve with trace of median septum
Locality: Ponta Grossa, Brazil

Lingula subpunctata Knod

Fig. 9 Cast of ventral umbo showing pedicle slit

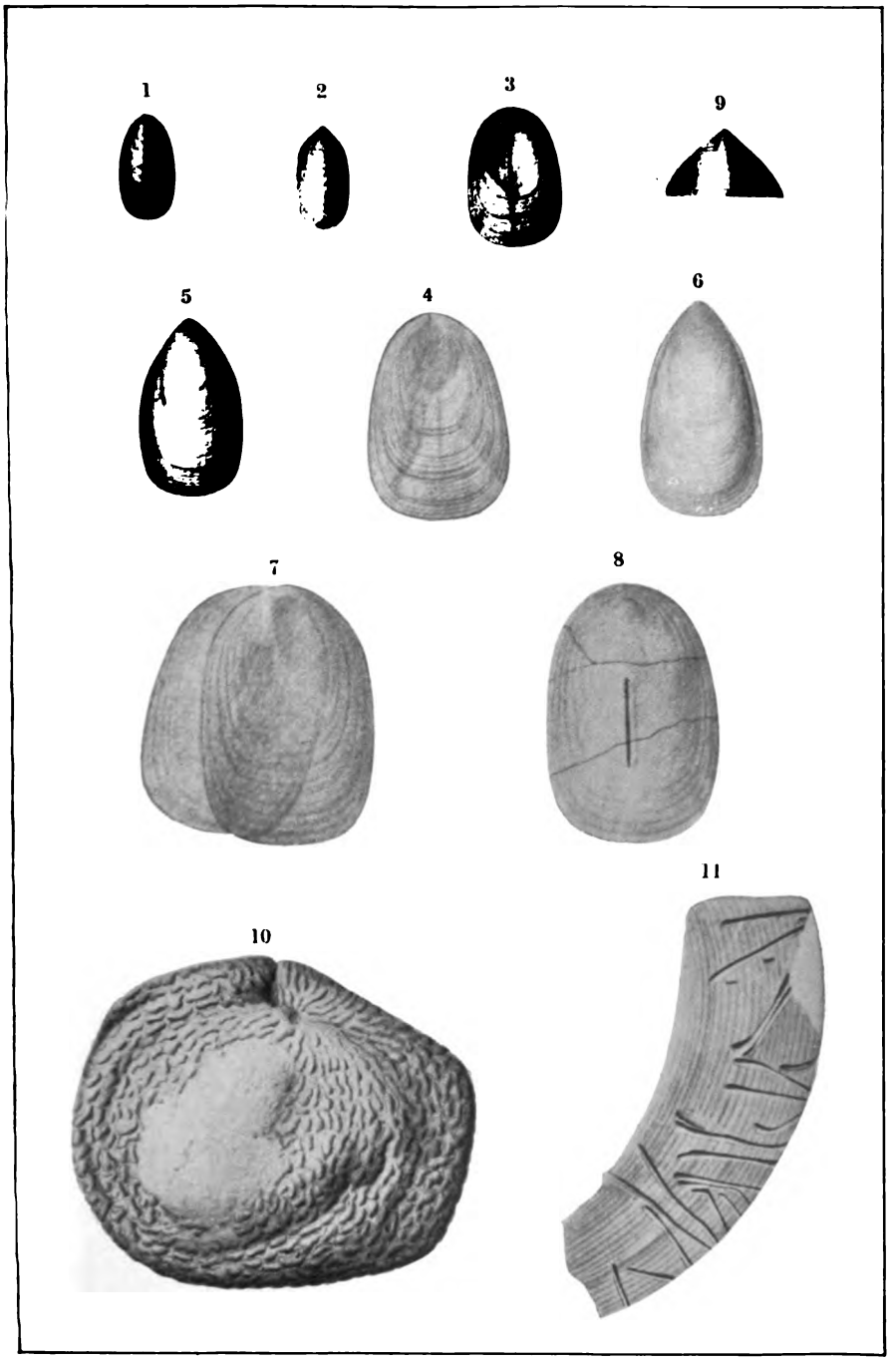
Problematicum

Fig. 10 Figure of a round cystoid body with a submarginal perforation or puncture from which radiates a pustular ornament. x 2
Locality: Jaguariahyva, Brazil

Clionolithus priscus McCoy

Fig. 11 A series of clavate tubes of this boring sponge in a shell of Ptomatis moreirai. x 1.5
Locality: Ponta Grossa, Brazil

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Plate 33

205

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Serpulites sica Salter

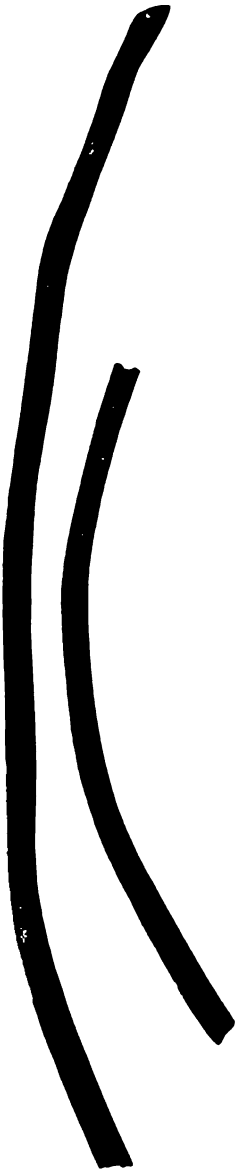
Fig. 1 Portions of flattened chitinous tubes with thickened edges
Locality: Ponta Grossa, Brazil

Plant (or branched annelid?)

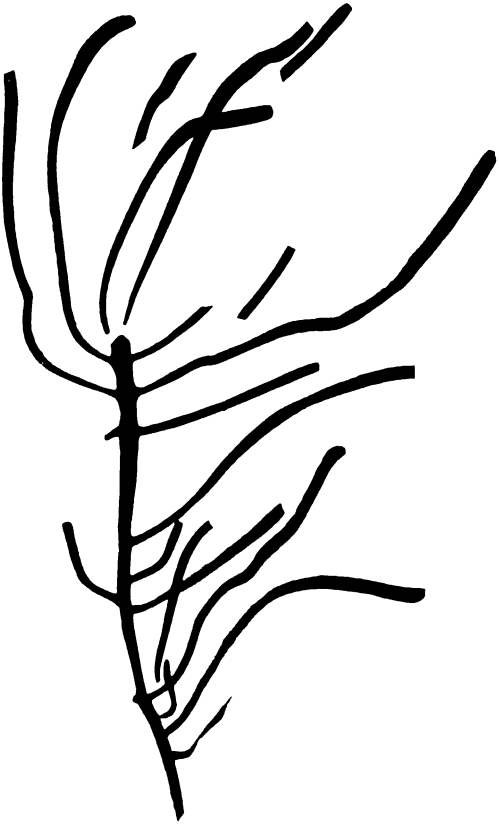
Fig. 2 A frond or colony on which the branches are flattened clavate tubes taking origin from a clavate stipe. x 1.5
Locality: Ponta Grossa, Brazil

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Plate 34

207

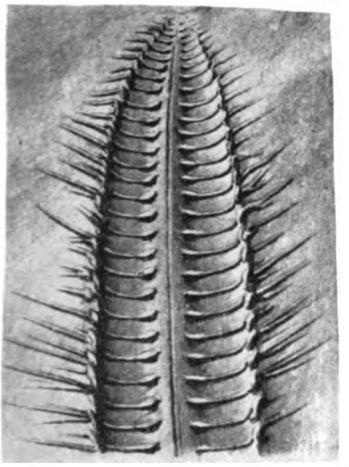
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Echinasterella? darwini Clarke

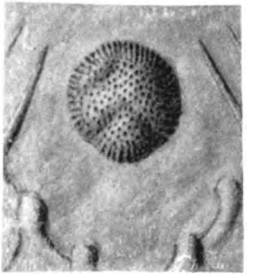
Fig. 1 Oral surface of an essentially entire specimen
2 Enlargement of part of arm
3 Madrepore plate. x 3
Locality: Ponta Grossa, Brazil

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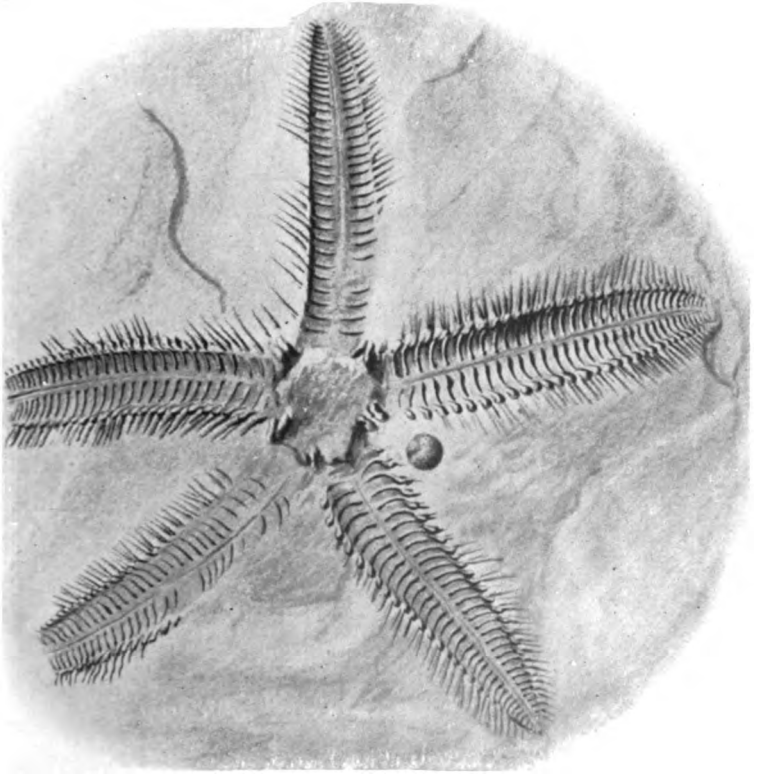
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209

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Aspidosoma ? pontis Clarke

Fig. 1, 2 Clusters of individuals in the soft shale, all exposing the ambulacral face

3 The entire oral apparatus. x 3

4 Part of oral frames and teeth. x 5

Locality: Ponta Grossa, Brazil

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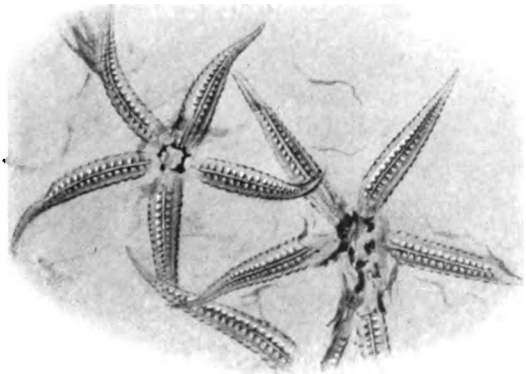
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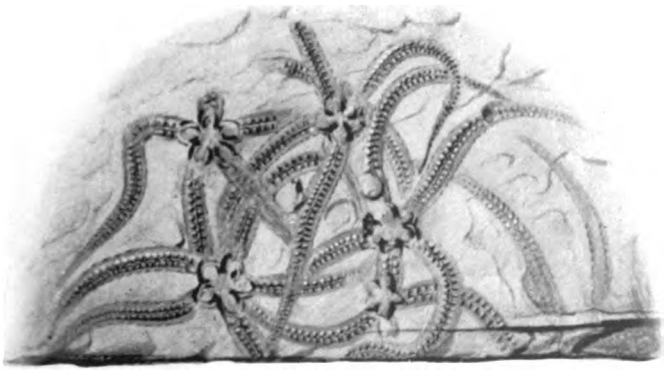
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INDEX

Accessions to collections, 63–78
Adirondacks, southern, Paleozoic physiography, 80–93
Ambrosia beetles, 39
Apple tent caterpillar, 35
Archeologist, report of, 45–57
Archeology, bulletin, 61; collection, accessions to, 77–78
Areal geology, 16–21
Art museum, 9
Aspidosoma pontis, 210
Auringer collection, 47–54

Bark borers, 39
Bellerophon quadrilobatus, 164
Berkey, Charles P., cited, 20
Black and Mohawk valleys, bulletin on glacial waters, 59
Black Cape, section of Siluric rocks on Bay of Chaleur, 31
Botanist, report, 33–35; bulletin, 61
Brazil, illustrations of Devonic fossils, 140
Broadalbin quadrangle, bulletin on geology of, 58
Brown-tail moth, 37
Bulletins, in press, 61

Calmonia ocellus, 154
signifer, 156, 158
var. micrischia, 158
subseciva, 160
Cardiomorpha colossea, 172
Chaleur, Bay of, section of Siluric rocks, 31
Champlain valley, ancient waters, 22
Chonetes falklandicus, 198
hallei, 200
skottsbergi, 198
Cicada, periodical, 40
Clarke, John M., Origin of the Gulf of St Lawrence, 132–37; A Notable Trilobite from the Percé Rock, 138–39; Illustrations of the Devonic Fossils of Southern Brazil and the Falkland Islands, 140
Clionolithus priscus, 204
Clove quadrangle, 20
Code of Handsome Lake, bulletin, 61
Codling moth, 36
Coelospira colona, 194
Conularia africana, 162
ulrichana, 162
Cryphaeus, 152
allardyceae, 150
Cryptonella baini, 182
Cushing, H. P., cited, 80, 81, 82, 85, 86, 87, 89, 90, 92, 93, 94
Cypricardella olivieria, 178
Cyrphaeus australis, 152

Dalmanites *sp.* 154
acacia, 148
accola, 150
falklandicus, 148
Dannemora quadrangle, 22
Derbyina smithi, 182
whitiorum, 194
Devonic fossils of southern Brazil and the Falkland Islands, 140
Diaphorostoma allardycei, 164

Earthquakes, record, 28
Echinasterella darwini, 208
Economic and general geology, accessions to collection, 63
Elm leaf beetle, 38, 40, 60
Entomologist, report, 35–42
Entomology, bulletins 60, 61; accessions to collection, 64–73
Eurypterida, memoir on, 30–31
Explanation of plates, 141–210

Fairchild, H. L., bulletin on glacial waters in the Black and Mohawk valleys, 59; cited, 21
Falkland Islands, illustrations of Devonic fossils, 140
Fall army worm, 38

Digitized by Google

Felt, E. P., bulletin on elm leaf beetle and white-marked tussock moth, 60
Flies, 40
Forest pests, 39–40
Forest tent caterpillar, 35
Fruit tree pests, 36

Gall midges, 40
Garnet deposits of Warren county, 95–102
Geologic map, condition of survey in western New York, 17; in northern New York, 17; in southeastern New York, 20; Hudson-Champlain valley, 22; new bulletins, 58, 61
Geological survey, report on, 16–33
Geology bulletins, 58–60; in press, 61
Gipsy moth, 37
Glacial waters in the Black and Mohawk valleys, bulletin on, 59
Goldthwait, cited, 22
Goniophora abbreviata, 178
Gordon, C. E., cited, 20
Grain pests, 37
Grass pests, 37–38
Green maple worm, 35

Hessian fly, 38
Hickory bark beetle, 39
Hill, B. F., cited, 93
Historical museum, provision should be made for, 8
Homalonotus, two specimens from the Percé Rock, 138–39
herscheli, 146
noticus, 142, 144
(Schizopyge) parana, 146
Hooper, F. C., cited, 102
House fly, 40
Hudson, George H., Use of the Stereogram in Paleobiology, 103–5; plates, 106–30
Hyolithus subaequalis, 162

Industrial geology, 25–28
Industry, museum of, proposed, 8
Insect pests in institutions, control, 41
Iroquois rites and folklore, study of, 56–57

Janeia bokkeveldensis, 176
braziliensis, 176

Kemp, James F., cited, 19, 80, 82, 89, 93, 100, 102; bulletin on the mineral springs of Saratoga, 59
Kionoceras zoilus, 162

Lake Pleasant quadrangle, 17
Lake Vermont, glacial, 21
Law, State Museum, 6
Leptocoelia flabellites, 194
Leptodomus capricornus, 178
ulrichi, 180
Leptostrophia concinna, 196
mesembria, 194
Lingula keideli, 204
lamella, 204
lepta, 204
scalprum, 204
subpunctata, 204
Locust leaf miner, 39
Logan, Sir William, cited, 133

Magnus, H. C., cited, 102
Maple scale, cottony, 39
false, 39
Map, geologic, *see* Geologic map
Memoirs, in press, 61
Merrill, F. J. H., cited, 102
Meteorites, 78–79
Midge galls, 41
Miller, W. J., bulletin on geology of the Broadalbin quadrangle, 58; Early Paleozoic Physiography of the Southern Adirondacks, 80–93; Garnet Deposits of Warren County, 95–102; cited, 17, 93
Mineral resources, investigation and description, 25
Mineral Springs of Saratoga, 19; bulletin on, 59
Mining and quarry industry of New York, bulletin on, 59
Modiomorpha? scaphula, 180
Mohawk valley, bulletin on glacial waters in, 59

Digitized by Google

Mollusca, New York, monograph, 44
Mooers quadrangle, 22
Mosquitos, 40
Mount Morris meteorite, 78–79

National plant quarantine act, 37
Newland, D. H., cited, 93, 100, 102; bulletin on mining and quarry industry, 59
Nuculana inornata, 168
Nuculites pacatus, 168
parai, 166
reedi, 166
sharpei, 166
Nursery inspection, 42

Ogilvie, I. H., cited, 94
Orbiculoidea baini, 200
bodenbenderi, 200
collis, 202
Orthoceras *sp.*, 162

Palaeanatina erebus, 178
Palaeoneilo magnifica, 168, 170
rhysa, 168
sanctricrucis, 170
sculptilis, 170
Paleobiology, use of the stereogram, 103–5; plates, 106–30
Paleontology, report on, 30–33; bulletin, 61; accessions to collection, 64
Paranaia margarida, 182
Pear midge, 37
Pear thrips, 36
Pennaia pauliana, 156
Percé rock, a notable trilobite from, 138–39
Petroleum compounds as insecticides, 35–36
Pholadella *cf.* radiata, 180
Phthonia epops, 180
Pilsbry, A. H., Monograph of the New York Mollusca, 44
Plant quarantine act, 37
Plates, explanation of, 141–210
Plectonotus (Bucaniella) dereimsi, 164
(Bucaniella) hapsideus, 164
Pleurodapis multicincta, 174
Proboloides cuspidatus, 160
pessulus, 160
Prothyris (Paraprothyris) knodi, 172
Ptomatis moreirai, 166
Public art museum, 9
Publications, 57–61

Rensselaeria falklandica, 182
Ruedemann, Rudolf, cited, 80, 90, 91, 93, 94

St Lawrence, Gulf, origin of, 132–37
St Lawrence county, talc deposits, 25; zinc, 26–28
Saratoga, mineral springs, 19; bulletin on, 59
Schenectady quadrangle, bulletin on glacial geology, 58
Schizobolus truncatus, 200
Schuchertella agassizi, 196
sanctricrucis, 198
sulivani, 196
Scientific collections, condition, 15–16
Scientific publications, 57–61
Seismologic station, 28–30
Serpulites sica, 206
Shade tree pests, 38–39
Sphenotus lagoensis, 178
Spirifer antarcticus, 184
contrarius, 192
hawkinsi, 184
iheringi, 188, 190
katzeri, 192
kayserianus, 186
lauro-sodreanus, 190
parana, 192
Spraying, fundamentals of, 41
Staff of the Science division and State Museum, 62–63
State Museum, law, 6; statutory conception, 6–7; idea and place in polity of the State, 7–9; educational function, 9–15
Stereogram, use in paleobiology, 103–5; plates, 106–30

Digitized by Google

Stoller, James H., bulletin on glacial geology of the Schenectady quadrangle, 58
Surficial geology, 21–25

Talc deposits, St Lawrence county, 25
Tarrytown quadrangle, 20
Tentaculites crotalinus, 164
jaculus, 164
Tropidocyclus antarcticus, 164
Tussock moth, white marked, 40, 60

Ulrich, E. O., cited, 80, 85, 86, 87, 94

Vermont waters, 22

Walcott, C. D., cited, 89, 94
Warren county, garnet deposits, 95–102
White grubs, 37
Whitlock, H. P., Mount Morris Meteorite, 78–79
Woolly bark louse, 39

Zinc, St Lawrence county, 26–28
Zoologist, report, 43–44
Zoology collection, accessions to, 73–76

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No. 547 ALBANY, N. Y. JULY 15, 1913

New York State Museum

JOHN M. CLARKE, Director

EPHRAIM PORTER FELT, State Entomologist

Museum Bulletin 165

28TH REPORT OF THE STATE ENTOMOLOGIST

ON

INJURIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK

1912

	PAGE
Introduction	5
Injurious insects	13
Codling moth	13
Hessian fly	31
Fall army worm	42
Elm leaf beetle	47
White grubs and June beetles	56
Hickory bark borer	63
Pear thrips	70
Queen blow fly	75
Georgian flesh fly	80
Use of oil on dormant trees	83
Notes for the year	93
Fruit tree insects	93
Forest insects	99
Miscellaneous	104
Publications of the entomologist	113
Additions to collections	120
Appendix: a study of gall midges	127
Explanation of plates	227
Index	255

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New York State Education Department
Science Division, February 15, 1913

Hon. Andrew S. Draper LL.D.
Commissioner of Education

SIR: I have the honor to transmit herewith the manuscript and accompanying illustrations of the annual report of the State Entomologist, for the fiscal year ending September 30, 1912, and I recommend the same for publication as a bulletin of the State Museum.

Very respectfully
JOHN M. CLARKE
Director

STATE OF NEW YORK
EDUCATION DEPARTMENT
COMMISSIONER'S ROOM

Approved for publication this 19th day of February 1913



Commissioner of Education

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EPHRAIM PORTER FELT, State Entomologist

Museum Bulletin 165

28th REPORT OF THE STATE ENTOMOLOGIST 1912

Dr John M. Clarke, Director of Science Division

I have the honor to present herewith my report on the injurious and other insects of the State of New York for the year ending September 30, 1912.

The past season was remarkable because of the superabundance of the common apple tent caterpillar in the Hudson and Mohawk valleys and on the borders of the Adirondacks. The pests were so numerous that most of the wild cherries on the roadside were defoliated and many orchards severely injured. There were reports of local damage here and there by the allied forest tent caterpillar; in several sections extended tracts were stripped of foliage. There is at least a fair probability of the insect being more abundant another season and possibly causing serious injury locally. The green maple worm, so numerous last year, attracted no attention the past season.

Petroleum compounds as insecticides. Dead and dying trees in several Greene county orchards which had been sprayed the preceding fall with a commercial preparation of petroleum, led to a careful study of the cases and the behavior of the trees through the season. A comparison was also made between the condition of these trees and injury of earlier years following applications of petroleum. We were unable to note any material difference between the two and, furthermore, observed a marked restriction of the damage to trees or even portions of trees which had received the application. A detailed discussion of our findings is given below, and after a careful study of the various phases of the matter we were forced to conclude that a certain measure of

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risk attaches to the application of mineral oils or preparations of the same to trees in a dormant condition.

Fruit tree pests. The experiments of the last three years against the codling moth have been continued in the orchard of Mr Thomas Albright, New Baltimore, and very satisfactory returns obtained. The check or unsprayed tree produced only 38.95 per cent of sound fruit, while other trees of the same variety, less than 100 feet away, yielded over 97, and in some instances, more than 98 per cent of worm-free apples. The results obtained in this experiment and those of earlier years were checked by a careful study of representative trees in the orchards of Messrs W. H. Hart, Poughkeepsie, and Edward Van Alstyne, Kinderhook. These latter were sprayed under strictly commercial conditions with no expectation at that time of their being subjected to a test later. The results in these commercial orchards were exceedingly gratifying. The northern spies belonging to Mr Hart produced an average of over 98 per cent of sound fruit, while the greenings and Baldwins on the Van Alstyne place gave an average of over 96 per cent of worm-free apples. The results of the past four years' experiments go far to show that under normal crop conditions one thorough and timely spraying for the codling moth should result in producing from 95 to 98 per cent of sound fruit. These tests are of great practical value to the fruit grower, since they afford a reliable basis for correctly estimating the value of spray applications.

The pear thrips, a minute insect which blasted or nearly destroyed the pear crop in a few orchards in the Hudson valley, was studied with special reference to conditions favoring injury, and the efficacy of spraying with a tobacco preparation demonstrated. The insect, potentially a very dangerous form, is discussed in this report. The work of the pear midge was investigated and a number of extremely desirable photographs of the larva and its work secured.

Gipsy moth. The danger of injury by this notorious pest was emphasized by the discovery of a small colony, practically restricted to a city block at Geneva. A personal examination of the locality showed that the infestation was probably of three or four years' standing. The chances are at least fair that the insect was introduced in that locality with nursery stock, though no undoubted evidence as to the source of the infestation has been adduced. We may expect the discovery of similar colonies from time to time, and for a period at least, no effort should be spared to

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exterminate such outlying infestations, as this policy is much cheaper and decidedly more advantageous to the general welfare than the adoption of repressive measures with the inevitable slow spread of the insect and shortly the greatly increased cost of controlling the pest incident to its being distributed over an extended area. Such measures are also advisable, since checking the normal spread is most advantageous for the development of introduced parasites, a number of which have already been established in this country.

The recent enactment of a national plant quarantine act, recommended by the Entomologist and his associates in other states, is an important step in advance and should prove of great service in restricting the spread of this and other injurious insects as well as preventing the introduction of dangerous pests.

Brown-tail moth. This species has attracted comparatively little attention the past season, though it has become established in the northwestern corner of Massachusetts and it is only a question of time before it will make its way into this State. The danger of this pest being introduced on nursery stock grown in infested sections still exists and should not be overlooked simply because a portion of the State is contiguous to infested territory. The winter nests are so characteristic that there should be little difficulty in identifying the insect and at the outset prevent its becoming excessively abundant.

Grass and grain pests. White grubs have been extremely numerous in portions of Albany, Columbia and Rensselaer counties, at least. They were so abundant in many places as practically to kill the grass over areas half an acre or more in extent. The roots were almost entirely destroyed and in many fields much of the sod was, as a consequence, torn loose where a horse rake was used. The outbreak was taken advantage of to study in representative spots, the work of the grubs, their habits and natural enemies, with special reference to methods of control. A detailed account of our investigations is given in this report.

The Hessian fly caused serious losses in the wheat-growing section of western New York, destroying entire fields and, in many cases, reducing the yield by 50 per cent. A personal investigation was made of the injury for the purpose of ascertaining any peculiarities in its inception and determining the probabilities of serious damage another year. A number of parasites were reared from infested wheat stems collected in representative areas. An extended discussion of this insect is given on a subsequent page.

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The fall army worm, another grass and grain pest, was excessively abundant in the vicinity of New York City, seriously injuring lawns, destroying millet and corn and feeding upon a variety of grasses. This outbreak was also investigated and a detailed account of the insect has been prepared.

Shade tree pests. The widespread and severe injuries of earlier years by the elm leaf beetle in the Hudson valley in particular, amply justified extended observations the past season. It was found that the exceptional damage in 1911 resulted in a feeble growth and weakened trees the past season. The early portion of the spring was unusually cool and moist, and largely as a result of these conditions we believe injury by this pest was not so severe as last year. There was a marked irregularity in the work of the beetle, some trees in a locality and in certain cases some localities being almost exempt from injury, while in others the damage was relatively severe. A portion of this may be explained, possibly by more thorough spraying. Experiments were conducted with sweetened and unmodified arsenate of lead for the purpose of ascertaining if any material advantage was to be gained by the addition of a cheap sugar or molasses. There was no marked difference between the two series and our earlier work with poisons was confirmed in large measure.

The false maple scale continues abundant in the vicinity of New York City and was a subject of considerable correspondence during the summer. The cottony maple scale was also responsible for a number of complaints.

Forest pests. The hickory bark beetle has continued its destructive operations in the vicinity of New York City. The abundance of this pest and the hearty cooperation of Mr J. James de Vyver, Mount Vernon, made possible a series of tests for the purpose of finding some method which could be relied upon to destroy the insect after the beetles had entered the trees. Studies in the field showed that in some localities many of the grubs died within a few weeks after hatching and before they were able to cause material injury. A detailed discussion of this work, together with investigations upon the biology of the pest and its natural checks, is given on a subsequent page.

Many of the white pines in the vicinity of Albany have been killed in recent years by bark borers. A study of the conditions showed that in all probability this attack was the outcome of extreme droughts and very low winter temperatures. Persons

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having trees which were attacked by these pests have been advised to cut and burn all infested pines prior to the opening of another season.

Hosts of Ambrosia beetles belonging to the genus Platypus attacked freshly sawn, sappy mahogany in the yard of a veneer cutting company near New York City and inflicted severe loss besides causing grave apprehensions. An investigation showed that the insects originated from a shipload of logs from Panama. The infested material was removed and the few insects remaining soon disappeared.

The destructive work of the locust leaf miner, noticed in our preceding report, was studied the past season and additional information secured in relation to its habits and methods of control. The most severe injury, as in 1911, resulted from the feeding of the beetles.

The woolly bark louse of the white pines has been the occasion of several complaints during the past season, and an investigation showed that in some instances at least, large trees were seriously weakened, if not destroyed, by this insect.

A previously unknown though sparse colony of the periodical Cicada was located at Geneseo as an outcome of the interest aroused by the appearance of the enormous brood last year.

Flies and mosquitos. There has been a general interest in controlling the house fly and preventing the superabundance of mosquitos. Both of these insects have been the subject of correspondence, and a number of bulletins giving directions for remedying undesirable conditions have been distributed.

An unusual departure was the working out of the life history of a common blowfly, Phormia regina Meign., and a flesh fly, Sarcophaga georgina Wied., under controlled conditions. These two insects, though exceedingly common, were comparatively unknown except in a very general way. The details of this investigation, undertaken for the purpose of solving a specific problem, are given more fully in this report.

Gall midges. This large group of small flies has continued to receive attention. We have succeeded in identifying the wheat midge of Fitch, which proved to be an undescribed species, discovered and described a second form recorded as living in heads of American wheat, and reared another. The last was identified through the cooperation of European entomologists as Thecodiplosis mosellana Gehin. In addition, a number of new gall

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midges have been reared from various food plants and described. The outbreak by the Hessian fly, noted above, and an abundance of the pear midge in the vicinity of Albany afforded opportunity for additional studies of two economic forms.

Lectures. The Entomologist, as in past years, has delivered a number of lectures upon insects, mostly economic forms, before various agricultural and horticultural gatherings. This work enables him to become personally acquainted with the problems of various localities and has been greatly facilitated by a chart showing the results secured in codling moth experiments of recent years.

Publications. A number of brief, popular accounts of the more injurious species of the year were widely circulated through the agricultural and local press. The important publications, aside from the report for last year, are: *The Elm Leaf Beetle and the White Marked Tussock Moth* (Museum Bulletin 156), *Control of Insect Pests in Institutions, The Identity of the Better Known Midge Galls, The Fundamentals of Spraying* and several papers describing new species of gall midges. A list of the more important publications is given on a subsequent page.

Collections. There have been material additions to the collections through the efforts of members of the office staff, and also by exchange and donation. Through the courtesy of Dr Otto Nüsslin of Karlsruhe, Germany, we received an excellent series of European bark beetles. Mr Henry Bird of Rye, generously donated an admirable lot of reared stem borers belonging to Hydroecia or closely allied genera, a number of these forms being almost unrepresented outside Mr Bird's exceptionally fine collection. The work of arranging and classifying the museum collections has continued whenever opportunity offered. Mr Young did considerable miscellaneous work upon the beetles or Coleoptera, giving special attention to the flea beetles, Halticini of the Chrysomelidae and to the June beetles, Lachnosterna and its immediate allies of the Scarabaeidae. An excellent series of genitalic mounts was made in this latter group.

The value of the collections has been greatly increased by microscopic preparations. Specimens of the Scolytidae received from Doctor Nüsslin and noted above were put in balsam mounts. There were, in addition, two hundred such preparations of gall midges, mostly from reared material, and a number of scale insects, some previously unrepresented in the collections, which were similarly treated. The value of this material is much enhanced when placed

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in such preparations, since the latter are permanent in character and, in most of the species mounted, necessary for the identification of the insect.

The series of plant groups designed to serve as an embellishing and instructive feature of the enlarged exhibit now in preparation is practically completed. There has been special collecting for this exhibit.

The more ample facilities of the new quarters bring added responsibilities in the opportunity they offer of making the State collection of insects, both exhibit and reference, thoroughly representative. The magnitude of such a task is appreciated by very few. The Entomologist recently assembled, with the cooperation of recognized authorities in various groups, the best obtainable figures as to the number of American insects. The data is tabulated below.

Hymenoptera	10 000	Orthoptera	950
Coleoptera	11 255	Neuroptera and Pseudoneuroptera	2 000
Diptera	9 100	Thysanoptera	118
Siphonaptera	115	Other small orders	500
Lepidoptera	6 622		
Hemiptera	3 328		
			43 988

A recent catalog of the insects of New Jersey, a state with a considerably smaller area and lacking the climatic and other diversities of New York, lists over 10,000 species. It seems to us conservative to place the probable number of insect species existing in this State at twice that figure. A thoroughly representative collection of New York forms should therefore contain well toward 20,000 native species, and since each has at least four well-marked stages, some 80,000 different forms. Many species and a great number of the stages are unknown. There is ample to occupy a well-equipped corps of entomologists for many years, not to mention the much additional labor involved in assembling and maintaining greatly enlarged entomological exhibits.

Nursery inspection. The nursery inspection work conducted by the State Department of Agriculture has resulted in the office being requested to make numerous identifications and also recommendations in regard to the policy which should be pursued by the State. Many of the specimens submitted for name were in poor condition, and as they may represent any stage in insect development and frequently originate in a foreign country, such determinations are

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laborious and time-consuming. The correct identification of such material is, however, very important, since the disposition of large shipments of nursery stock must depend, in considerable measure, upon our findings.

Miscellaneous. In cooperation with the Division of Visual Instruction, an excellent and somewhat extended series of photographs, mostly of injurious or common insects, has been secured. This material was all taken in connection with other collecting, it only being necessary to pose the specimen for the photographer.

General. The work of the office has been materially aided, as in past years, by the identification of a number of species through the courtesy of Dr L. O. Howard, chief of the bureau of entomology, United States Department of Agriculture, and his associates. Several correspondents have aided in securing valuable specimens and many have rendered efficient service by transmitting local data respecting various insects. It is a pleasure to note that there has been, as in the past, most helpful cooperation on the part of all interested in the work of the office.

Respectfully submitted

EPHRAIM PORTER FELT
State Entomologist

October 15, 1912

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INJURIOUS INSECTS

CODLING MOTH

Carpocapsa pomonella Linn.

Practical field work with the codling moth was continued the past season and the results of the previous three years of work very satisfactorily confirmed. The spraying of 1912 was confined to young and moderate sized Ben Davis trees on the farm of Thomas Albright, New Baltimore. A power sprayer was used and an effort made to do thorough work, yet the applications were by no means excessive. A check or unsprayed tree produced only 38.95 per cent of sound fruit, while those in the immediate vicinity and sprayed as described above, yielded from 97.53 to 99.53 per cent, or an average of 98.69 per cent, of worm-free apples. The other plot similarly treated comprised larger trees and produced from 95.17 to 98.77 per cent, or an average of 97.26 per cent, of sound fruit. Considering that this spraying was done under adverse conditions and the yield of individual trees by no means excessive, the results are all that could be expected. These returns were checked by examinations of the yields from representative trees in the orchards of W. H. Hart, Poughkeepsie, and of Edward Van Alstyne, Kinderhook. These trees were sprayed last spring in the ordinary practical manner and with no expectation that any of the trees would later be selected for test purposes. In the orchard of Mr Hart, his northern spy trees produced from 97.87 to 98.77 per cent, or an average of 98.23 per cent, of sound fruit. Mr Van Alstyne's trees, composed of Baldwins and greenings, yielded from 95.12 to 97.50 per cent, or an average of 96.20 per cent, of worm free apples. None of these trees were sprayed more than once during the season with a poison, and the applications were made within the week or ten days necessary to secure the best results. It should be recalled, in this connection, that our earlier work has shown that sprayings made about three weeks after the blossoms fall are only about one-half as effective as the applications after the dropping of the blossoms and before the calyx cup is closed.

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Life history and habits. Before giving the details of the experimental work, it may be well to outline the life history of this pest, since a knowledge of its habits is essential to satisfactory control work. The apple worm or codling moth, as is well known, winters in a tough, silken cocoon, usually located under the rough bark of trees. With the appearance of warm weather in the spring, which in New York State means late April and early May, the caterpillars transform within their silken retreats to brown, apparently lifeless pupae, and a week or ten days after the blossoms fall the moths commence to emerge and continue to appear throughout the greater part of June. The minute, whitish eggs are deposited largely upon the leaves, though a number may be found on the young fruit. They hatch in about a week and, as a consequence, the young apple worms of the first brood may be entering the small fruit from early in June, approximately three weeks after the blossoms fall, to nearly the end of the month or even later. The caterpillars require about four weeks to complete their growth, at which time they desert the fruit, wander to a sheltered place, sometimes excavate an oval cell in the wood or bark and spin a cocoon. They transform once more to pupae and in about two weeks, namely the last of July or in August another brood of moths may appear. These in turn deposit eggs which hatch in due time and the young larvae usually enter the side of the fruit. Two broods appear to be the rule in the northern fruit-growing sections of the United States, though some investigators claim a third in the southwest.

Experimental work. May 29th two lots of trees were sprayed on the farm of Thomas Albright, New Baltimore; 2 pounds of arsenate of lead (15 per cent arsenic oxid) being used to 50 gallons of water and 1 gallon of a lime-sulphur wash to 40 gallons of spray. A straight discharge variable nozzle was used on one line of hose, while the other was equipped with two angle Friend nozzles, the extensions in each case being about 8 feet long.

Plot 1 comprised five moderate sized Ben Davis trees just back of the house and southwest of the barn. These trees are about 18 feet high with a spread of 20 to 25 feet and were well loaded with young apples, except tree C, one-half of which bore practically no fruit. The blossoms had mostly fallen, only a few remaining

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here and there. The trees were sprayed about ten o'clock in the morning, there being a high wind and some 70 gallons of mixture was applied to the five trees. There was considerable dripping and more spray material was used than really necessary, owing to the wind.

An examination of conditions on August 16th showed little of special significance and not enough apples on the ground to warrant picking up the fruit. On September 17th the fallen apples were picked up and classified, and again nothing particularly significant noted. The remainder of the fruit was secured October 14th. The data relating to all the trees is tabulated below:

Plot 1 Thomas Albright orchard, New Baltimore, N. Y. Variety, Ben Davis. 1912

TREE	DATE	TOTAL FRUIT		CLEAN FRUIT		WORMY FRUIT						
				Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit 1	Exit 2
A	Sept. 17	Drops	89	78	.....	11	.....	.....	.....	11	6	.....
	Oct. 14	Drops	80	74	.....	6	.....	.....	.....	6	3	.....
	Oct. 14	Picked	2991	2952	.....	39	.....	.....	5	34	16	.....
			3160	3104	98.22	56	1.78	.....	5	51	25	.....
B	Sept. 17	Drops	235	219	.....	16	.....	2	.....	14	10	.....
	Oct. 14	Drops	86	81	.....	5	.....	1	1	3	3	.....
	Oct. 14	Picked	2366	2281	.....	85	.....	3	.....	82	18	1
			2687	2581	96.06	106	3.94	6	1	99	31	1
C	Sept. 17	Drops	33	27	.....	6	.....	.....	.....	6	4	.....
	Oct. 14	Drops	76	71	.....	5	.....	.....	2	3	4	1
	Oct. 14	Picked	1257	1215	.....	42	.....	3	4	35	17	.....
			1366	1313	96.12	53	3.88	3	6	44	25	1
D	Sept. 17	Drops	66	51	.....	15	.....	1	.....	14	12	.....
	Oct. 14	Drops	81	74	.....	7	.....	.....	.....	7	7	.....
	Oct. 14	Picked	1012	978	.....	34	.....	2	2	30	9	1
			1159	1103	95.17	56	4.83	3	2	51	28	1
E	Sept. 17	Drops	106	102	.....	4	.....	.....	.....	4	4	.....
	Oct. 14	Drops	67	65	.....	2	.....	.....	.....	2	2	.....
	Oct. 14	Picked	2593	2565	.....	28	.....	2	2	24	8	.....
			2766	2732	98.77	34	1.23	2	2	30	14	.....
Grand total..			11138	10833	97.26	305	2.74	14	16	275	123	3

It will be seen by referring to these data, that the yield of the five trees in this plot was fairly uniform, though trees C and D

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produced only 1366 and 1159 apples, respectively, the others approximating 3000. The variation in percentage of sound fruit is not great and the average for the entire plot is excellent. It will be noted that a very large proportion of the wormy fruit, namely 291 out of the total 305, were side wormy, only 30 being end wormy and more than half of this latter number, namely 16, being both end and side wormy.

Plot 2 comprised seven small Ben Davis trees located in a lot north of the house next to the woods and west of a small creek. These trees are 15 to 16 years old, 10 to 17 feet high and about 30 feet apart. The check tree was in the southeastern portion of the plot, next the small creek and in a position where thorough spraying was not easy. The wind continued high and about five gallons of spray were used for each tree, the treatment being continued until there was considerable dripping. The spraying was followed by a heavy shower in the afternoon and rain during the night. This plot was moderately well laden with fruit, and our subsequent data show that there was a fairly uniform yield, except possibly in the case of the check tree.

An examination of this plot on August 16th showed there had been some spotting of the foliage by the work of a Hemipteron. It was estimated at that time that the check tree would produce 50 per cent of wormy apples and there was observed in this tree an apple tent caterpillar's nest, something not seen upon those which had been sprayed. There was nothing particularly significant about the trees at the time the fruit was picked on October 14th. It is barely possible that the tree selected as a check was not entirely representative, since its position was such that the spraying of the previous year could hardly have been as thorough as in the case of the other trees. There is also a possibility that certain wormy apples may have been swept down the stream from trees above. We believe both of these factors are comparatively insignificant, though they may have had an influence upon the yield. The tabulation of the data secured from this plot and the check tree is given on the following page.

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Plot 2 Thomas Albright orchard, New Baltimore, N. Y. Variety, Ben Davis. 1912

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit 1	Exit 2
A	Sept. 17 Drops	24	19	.....	5	.....	1	.....	4	5	.....
	Oct. 14 Drops	7	5	.....	2	.....	1	.....	1	1	.....
	Oct. 14 Picked	1828	1799	.....	29	.....	3	5	21	13	.....
		1859	1823	98.07	36	1.93	5	5	26	19	.....
B	Sept. 17 Drops	19	18	.....	1	.....	.....	.....	1	1	.....
	Oct. 14 Drops	8	7	.....	1	.....	.....	.....	1	1	.....
	Oct. 14 Picked	1036	1033	.....	3	.....	.....	.....	3	1	.....
		1063	1058	99.53	5	.47	.....	.....	5	3	.....
C	Sept. 17 Drops	32	30	.....	2	.....	.....	.....	2	2	.....
	Oct. 14 Drops	7	6	.....	1	.....	.....	.....	1	.....	.....
	Oct. 14 Picked	998	994	.....	4	.....	.....	.....	4	2	.....
		1037	1030	99.33	7	.67	.....	.....	7	4	.....
D	Sept. 17 Drops	19	14	.....	5	.....	.....	1	4	5	.....
	Oct. 14 Drops	10	8	.....	2	.....	1	1	.....	1	.....
	Oct. 14 Picked	1827	1788	.....	39	.....	3	5	31	10	.....
		1856	1810	97.53	46	2.47	4	7	35	16	.....
E	Sept 17 Drops	16	15	.....	1	.....	.....	.....	1	1	.....
	Oct. 14 Drops	9	9	.....	.....	.....	.....	.....	.....	.....	.....
	Oct. 14 Picked	1219	1204	.....	15	.....	3	1	11	7	1
		1244	1228	98.71	16	1.29	3	1	12	8	1
F	Sept. 17 Drops	11	11	.....	.....	.....	.....	.....	.....	.....	.....
	Oct. 14 Drops	3	2	.....	1	.....	.....	.....	1	1	.....
	Oct. 14 Picked	1157	1150	.....	7	.....	.....	.....	7	2	.....
		1171	1163	99.32	8	.68	.....	.....	8	3	.....
G	Sept. 17 Drops	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Oct. 14 Drops	9	8	.....	1	.....	.....	.....	1	1	.....
	Oct. 14 Picked	1790	1778	.....	12	.....	1	.....	11	5	.....
		1799	1786	99.28	13	.72	1	.....	12	6	.....
Grand total..		10029	9898	98.69	131	1.31	13	13	105	59	1
					Check tree						
	Sept. 17 Drops	124	12	.....	112	.....	35	51	26	68	5
	Oct. 14 Drops	42	3	.....	39	.....	6	26	7	22	.....
	Oct. 14 Picked	712	327	.....	385	.....	171	161	53	103	.....
		878	342	38.95	536	61.05	212	238	86	193	5

It will be seen by referring to the above table that the yield of none of these trees was excessive, they producing from 1037 to 1859 apples or a total of 10,029. The percentage of worm-free fruit

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varied from 97.53 to 99.53 with an average of 98.69. As in the preceding plot, the side wormy apples largely predominate, there being a total of 118, while the end wormy amounted to but 26, half of these being both end and side wormy.

The contrast between this data and that obtained from the check tree is striking. The latter produced only 38.95 per cent of sound fruit, 450 of the 536 wormy apples being end wormy, while the relatively small number of 324 were side wormy, 238 of the latter being both end and side wormy. It will be seen that the check trees practically reverse the relations obtaining between end and side wormy and that the major proportion of the protection from codling moth injury is due to the destruction of the caterpillars before they enter the blossom end.

Tests in commercial orchards. It was deemed advisable, in connection with the experiments described above, to check up results by comparison with those obtained in commercial orchards. The spraying in the two selected was made with no foreknowledge that any such data would be used, and the results could therefore be hardly better than most practical orchardists might hope to obtain.

The first of these practical tests was in a young orchard belonging to Mr W. H. Hart of Arlington, near Poughkeepsie and close to Briggs station on the Hopewell branch of the Central New England Railroad. The orchard is on a moderately high hill, the trees are thrifty, about 18 years old, 30 feet apart and from 17 to 19 feet high. The trees selected were all nothern spies and an effort was made to secure only those which were fairly representative of the orchard, which latter, it may be stated, is in excellent condition and represents an advanced type of orchard management. The trees were sprayed, we are informed, May 24th or 25th when the blossoms had fallen just enough so that there was no danger of poisoning bees. Mr Hart used 7 pounds of Grasselli's arsenate of lead and 4 gallons of a homemade concentrated lime-sulphur wash to 150 gallons of water. This latter sufficed for the treatment of 50 to 70 trees. Those selected for the test were somewhat larger than the average and probably received about 2¾ gallons each. The fruit was picked October 18th and everything upon the trees and under them carefully classified.

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W. H. Hart orchard, Poughkeepsie, N. Y., October 18, 1912. Variety, spy

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit 1	Exit 2
A	Oct. 18 Drops	363	348	.....	15	.....	.....	.....	15	3	.....
	Oct. 18 Picked	1344	1338	.....	6	.....	.....	.....	6	2	.....
		1707	1686	98.77	21	1.23	.....	.....	21	5	.....
B	Oct. 18 Drops	887	837	.....	50	.....	4	2	44	17	1
	Oct. 18 Picked	1890	1881	.....	9	.....	.....	.....	9	5	.....
		2777	2718	97.87	59	2.13	4	2	53	22	1
C	Oct. 18 Drops	158	149	.....	9	.....	.....	.....	9	4	.....
	Oct. 18 Picked	715	710	.....	5	.....	.....	.....	5	1	.....
		873	859	98.40	14	1.60	.....	.....	14	5	.....
Grand total..		5357	5263	98.23	94	1.77	4	2	88	32	1

It will be seen by referring to the above tabulation that from 97.87 to 98.77 per cent of all the fruit, or an average of 98.23 per cent was worm free. The end wormy, it will be noted, were extremely few, only six occurring upon one tree and two of these being side wormy. This very high percentage of sound fruit can hardly be attributed to an enormous yield, since it will be noted that no tree produced over 2800 apples, while one bore but 873, there being no very material variation in the percentage of wormy apples between the two.

The second of these practical tests was in the orchard of Mr Edward Van Alstyne at Kinderhook and was restricted to three rather small greening trees and two moderate sized Baldwins located in the portion of the orchard where we had conducted experimental work in earlier years. The trees were selected for the purpose of securing as nearly as possible a fair representation of the average conditions obtaining, both as to yield and infestation. Mr Van Alstyne informs us that the trees were sprayed the last week in May, just after the petals had fallen, with 3 pounds of arsenate of lead to 50 gallons of water and a lime-sulphur wash testing 25° on the Baumé scale and diluted 1 to 25. This spraying was done, as was the case of Mr Hart, with no foreknowledge that any practical test would be made later. The greenings were picked October 10th and the Baldwins October 30th and everything upon the trees and under them carefully classified.

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Edward Van Alstyne orchard, Kinderhook, N. Y., 1912

TREE	DATE		TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
				Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Exit 1	Exit 2
Greening:												
A	Oct. 10	Drops	546	493	.....	53	.....	3	3	47	26	2
	Oct. 10	Picked	1997	1926	.....	71	.....	.....	6	65	4	.....
			2543	2419	95.12	124	4.88	3	9	112	30	2
B	Oct. 10	Drops	69	54	.....	15	.....	2	3	10	4	.....
	Oct. 10	Picked	1556	1517	.....	39	.....	4	1	34	4	.....
			1625	1571	96.68	54	3.32	6	4	44	8	.....
C	Oct. 10	Drops	60	57	.....	3	.....	.....	.....	3	2	.....
	Oct. 10	Picked	540	528	.....	12	.....	.....	.....	12	1	.....
			600	585	97.50	15	2.50	.....	.....	15	3	.....
Baldwin:												
A	Oct. 30	Drops	3321	3176	.....	145	.....	8	6	131	45	6
	Oct. 30	Picked	1666	1625	.....	41	.....	2	6	33	27	2
			4987	4801	96.27	186	3.73	10	12	164	72	8
B	Oct. 30	Drops	1466	1408	.....	58	.....	3	2	53	21	1
	Oct. 30	Picked	738	721	.....	17	.....	1	4	12	6	2
			2204	2129	96.59	75	3.41	4	6	65	27	3
Grand total..			11959	11505	96.20	454	3.80	23	31	400	140	13

It will be seen by reference to the above tabulation that the greenings produced from 600 to 2543 apples per tree, and from 95.12 to 97.50 per cent of worm-free fruit. The two Baldwin trees yielded 2204 and 4987 apples, respectively, 96.59 and 96.27 per cent being wormless. The very large number of drops on these latter trees (*a* produced 6 barrels of dropped fruit and 4 barrels of picked fruit, while *b* yielded 3 barrels of dropped fruit and 2 of picked apples) is explained by the fact that the picking was greatly hindered by a spell of rainy weather accompanied by more or less wind and, as a result, a very large proportion of the apples lay on the ground. The five trees as a whole yielded from 95.12 to 97.50 per cent of sound fruit or an average of 96.20 per cent. This is a somewhat lower average than that for the Poughkeepsie orchard and is probably explainable in part by the occurrence of interplanted trees of other varieties and a slight crowding and larger size which prevented to some extent the very thorough work obtaining at Poughkeepsie. It will be seen by reference to this table that only 54 apples were end wormy, 31 of these being both end and side wormy, while 431 were side wormy. The obvious

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inference is that most of the reduction in infestation was due to the thorough spraying of the upturned blossom ends and the consequent destruction of nearly all worms attempting to enter the fruit at this point.

A DISCUSSION OF RESULTS

The work in the Hudson valley has now extended over four seasons in orchards belonging to four different parties in as many distinct localities, and in each instance the spraying equipment and force on the place was used, the experimenter simply selecting representative trees and insisting upon thorough, though not excessively thorough work. Baldwins, greenings, northern spy and Ben Davis were well represented in the experimental trees selected. The diversity of season, location, equipment and men, and the different varieties prevent these experiments being classed as local or exceptional. They show what the practical fruit grower can and should obtain as a result of systematic spraying in regions where codling moth conditions are practically identical with those obtaining in the Hudson valley.

A study of the habits of the codling moth shows three well-defined periods when applications of poison may be more or less effectual.

The first comprises a week or ten days after the dropping of the white petals or bloom and during which the green calyx lobes remain open and the young apples upright in such a condition that the calyx cavity can be more or less filled with poison.

The second period is about three weeks after blossoming and is the time when the young codling moth larvae or apple worms hatch, begin feeding and enter the fruit.

The third period is the latter part of July or early August and is of special importance because the larvae of the second brood, or young apple worms, are then hatching and feeding on the leaves or entering the fruit.

Yields of unsprayed or check trees. The product of the unsprayed or check trees may be the basis for comparison in all experimental work, and special pains were therefore taken throughout the series to secure for this purpose trees which were representative of average conditions and so located that there would be very little or no interference with the experimental plots. Owing to various limitations it was impractical to have our check plots of the same size as those sprayed, though otherwise conditions were practically identical.

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Tabulation of yields from unsprayed or check trees

PLOT	SERIES	YEAR	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT					
				Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Per cent end wormy
Check...	1	1909	3251	2366	72.73	885	27.27	312	302	271	.....
Check...	2	1909	7015	5127	73.08	1888	26.92	674	630	584	.....
Check...	1	1910	711	202	28.41	509	71.59	186	240	82	.....
Check...	2	1910	2000	593	29.65	1407	70.35	700	324	383	.....
Check...	1	1911	5337	4540	85.06	797	14.94	379	166	252	.....
Check...	2	1911	14670	9860	67.21	4810	32.79	2048	949	1813	.....
Check...	2	1912	878	342	39.95	536	61.05	212	238	86	.....
Grand total.....			33868	23030	67.99	10832	32.01	4511	2849	3471	21.73

It will be seen that the check plots during this four-year period gave an average percentage of sound fruit amounting to 67.99, the yield in individual plots varying from 28.41 to 85.06 per cent. The smaller yields of good fruit, it should be noted, occurred on trees producing relatively few apples. The average percentage of end wormy fruit for these plots is 21.73, a marked contrast, as will be seen later, to what was obtained from the sprayed trees. The returns from the unsprayed trees may be briefly summarized as follows: Approximately one-third of the fruit was wormy and nearly two-thirds of the wormy apples were entered at the end, in other words, were end wormy. The importance of this data will be more fully demonstrated as we consider the returns from the various plots.

Results obtained from spraying during the first period. This treatment is given within a week or ten days after the blossoms drop, preferably as soon as possible thereafter and before the calyx lobes have closed. Since the codling moth larvae or apple worms do not hatch till a week or ten days after the close of this period, namely, about three weeks after blossoming, we are unable to see that the second treatment prior to the closing of the calyx cup, as ordinarily recommended, materially affects the situation so far as the codling moth is concerned, provided the first application has been thorough. This is evident when it is remembered that all that can be done by spraying during the period is to place the poison where it will be eaten by the caterpillars or apple worms, to appear later, as they attempt to enter the blossom end. The additional

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amount placed upon the foliage if a second spraying be given during this period, as will be seen shortly, is of comparatively small value in destroying codling moth larvae.

Summary of four years' work with one spray for the codling moth

PLOT	SERIES	YEAR	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT					
				Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Per cent end wormy
1	1	1909	30177	29818	98.81	359	1.19	33	18	308	
4	1	1909	20313	20017	98.55	296	1.45	31	6	259	
1	2	1909	21264	21042	98.96	222	1.04	23	18	181	
4	2	1909	9852	9683	98.27	169	1.73	19	13	137	
7	2	1909	19091	18617	97.52	474	2.48	51	32	391	
1	1	1910	1839	1664	90.48	175	9.52	16	21	138	
1	2	1910	8135	6677	82.08	1458	17.92	160	27	1271	
1	1	1911	16638	16515	99.26	123	.74	19	12	92	
1	2	1911	20802	20401	98.07	401	1.93	28	14	359	
1	1	1912	11138	10833	97.26	305	2.74	14	16	275	
2	2	1912	10029	9898	98.69	131	1.31	13	13	105	
Grand total			169278	165165	97.56	4113	2.44	407	190	3516	.353

The above tabulation shows that one spray during this period produced from 82.08 to 99.26 per cent of sound fruit or an average of 97.56 per cent for the four years, when comparisons are made between an equal number of plots in each year. In explanation it should be stated that the figures for several plots in 1909 were omitted simply to give a more nearly equivalent value to the returns obtained for the four-year period. Attention should be called to the low percentages of 1910, a season remarkable for the unusual destructiveness of the second brood and one presenting infrequent conditions which were further accentuated by the small yield of that year. Excluding the data for 1910, the lowest percentage of sound fruit obtained from one spraying was 97.52. It is worthy of note that only a little over ⅓ of 1 per cent (.353 per cent) of the wormy apples were end wormy. This, compared with the proportion of end wormy on the unsprayed trees, which latter amounts to 21.73 per cent, shows that the great reduction in wormy fruit was due to the destruction of the caterpillars or apple worms attempting to enter the apples at the blossom end, and indicates in a striking manner the importance of this early spray. The contrast is more evident if we raise the yield of the check or unsprayed trees to approximately that of the sprayed trees and the other data pro

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rata so as to present a fair comparison. In the following tabulation we have assumed that 400 apples would fill a barrel. This is an approximate figure and equally fair for both the sprayed and the unsprayed trees.

Comparative results of one spray during four seasons

TREATMENT	TOTAL FRUIT		TOTAL CLEAN		WORMY APPLES					
					End wormy			Side wormy		
	No.	Bbls.	No.	Bbls.	No.	Bbls.	Per cent	No.	Bbls.	Per cent
Sprayed	169278	423	165165	412¾	407	1	.353	3516	8¾	2.10
Unsprayed	169340	423¼	115150	287¾	22555	56¼	21.73	17355	48¼	18.37
Difference	62	¼	50015	125	22148	55¼	21.377	16839	39½	16.18

The contrast between sprayed and unsprayed fruit is evident at once from a scrutiny of the above figures. A yield of about 423 barrels should, if the trees are well sprayed but once, produce 412¾ barrels of sound apples, while unsprayed trees bearing an equal amount of fruit, would yield but 287¾ barrels of worm-free apples, a difference of 125 barrels. A comparison of the end wormy apples shows at once where most of the efficacy lies, there being but one barrel of end wormy fruit on the sprayed trees, while the others produced 56¼ barrels of such apples, a difference of 55¼ barrels. There is a marked, though not such a great contrast in the yield of side wormy apples. The sprayed trees, it will be seen, produced but 8¾ barrels of such fruit, while the unsprayed trees yielded 48¼ barrels, a difference of nearly 40 barrels. The same contrasts are also shown in the number of apples and the percentages of the various grades.

Results obtained from spraying during the second period. This treatment is given about three weeks after the blossoms fall and is applied at that time because the young caterpillars are then just beginning to feed and enter the fruit. Theoretically, making no allowances for peculiarities in habits, this spraying should give the best results, while as a matter of fact, returns indicate an efficiency approximately one-half that of the early treatment. Spraying at this time was done only in 1910 and 1911. The results are tabulated on the following page.

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Results of one spray applied late

PLOT	SERIES	YEAR	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT					
				Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Per cent end wormy
3.....	2.....	1910	7594	4355	57.35	3239	42.65	1485	326	1428	.....
4.....	1.....	1911	8969	8393	93.57	576	6.43	186	95	295	.....
4.....	2.....	1911	16815	13113	77.98	3702	22.02	1422	578	1702	.....
Grand total and per cent.			33378	25861	77.47	7517	22.53	3093	999	3425	12.26

The three plots receiving one late application during 1910 and 1911 gave an average percentage of sound fruit of only 77.47, there being a range for individual plots from 57.35 to 93.57. The average percentage of sound fruit is approximately midway between that obtained from one spraying and the yield of the check trees, namely, 77.47. The average benefit accruing from this one spray is approximately 10 per cent of the entire yield. The large percentage of end wormy, namely, 12.26, shows that this treatment lacks efficiency because of the failure to destroy caterpillars entering at the blossom end of the apples.

Results obtained from two sprayings. This means a treatment during the first period, that is within a week or ten days after the blossoms fall, and another spraying in the second period, namely, about three weeks after the blossoms drop.

Results obtained from two sprayings

PLOT	SERIES	YEAR	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT					
				Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Per cent end wormy
2.....	1.....	1909	10316	10206	98.93	110	1.07	4	7	99	.....
5.....	1.....	1909	19275	19084	99.01	191	.99	10	9	172	.....
2.....	1.....	1910	2846	2756	96.84	90	3.16	6	1	83	.....
2.....	2.....	1910	7316	6105	83.45	1211	16.55	127	10	1074	.....
2.....	1.....	1911	19994	19903	99.54	91	.46	5	3	83	.....
2.....	2.....	1911	34019	33510	98.50	509	1.50	53	54	402	.....
Grand total and per cent.			93766	91564	97.65	2202	2.35	205	84	1913	.308

The six plots receiving two sprayings during 1909–11 produced from 83.45 to 99.54 per cent of sound fruit or an average of 97.65,

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the end wormy fruit being less than ⅓ of 1 per cent (.308 per cent). The average gain in sound fruit resulting from this second application, if compared with the average percentage of worm-free apples obtained during the four-year period, amounts to only .09 per cent and this was accompanied by only a slight reduction in the percentage of end wormy apples.

Results obtained from three sprayings. These applications were distributed so that one was given in each of the above designated periods, namely, one within a week or ten days after the blossoms fell, the second about three weeks after the dropping of the bloom and the third the latter part of July. The second was designed to catch the young caterpillars of the first brood just as they were beginning feeding, while the third was directed against the young apple worms of the second brood.

Results obtained from three sprayings

PLOT	SERIES	YEAR	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT					
				Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Per cent end wormy
3	1	1909	9680	9582	98.99	98	1.01	8	10	80	
6	1	1909	7710	7633	99	77	1	6	3	68	
3	1	1911	20926	20830	99.54	96	.46	17	2	77	
3	2	1911	31119	30852	99.14	267	.86	60	23	184	
Grand total and per cent			69435	68897	99.22	538	.78	91	38	409	.185

It was unfortunate that in 1910 no plot received these three applications and, as a consequence, the average percentage for this treatment is somewhat higher than it should be. Even with this omission which, in a measure, is undoubtedly favorable to the three applications, the average percentage is 99.22, a gain for the third treatment representing only 1.57 per cent. It will be noted that there is a slight reduction in the average percentage of end wormy apples, this being approximately ⅕ of 1 per cent (.185 per cent).

COMPARATIVE SUMMARY

The following tabulation of comparative yields from the experimental plots during the first three years (1909—11) will prove instructive, since those from the plots sprayed three times, sprayed late and checks have been raised pro rata to make up for a deficiency

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in the number of plots or a reduced number of trees in the plots and the figures thus indicate fair comparative values. We have not included in this the returns from one spray during 1912, since there would be no material gain were this done as the figures are very nearly the same, and furthermore such inclusion would result in a disproportionate representation of trees receiving but one application. The figures in the tabulation given below for the plots sprayed three times are undoubtedly somewhat higher than they should be because there were none sprayed three times in 1910, a year when the second brood of the codling moth was extremely abundant and excessively injurious.

Comparative tabulation of yields for 1909-11

NUMBER OF SPRAYS	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT			
		Number	Per cent	Total	Total end wormy	Total side wormy	Total end and side wormy
1	98855	96117	97.23	2738	389	2459	110
2	93766	91564	97.65	2202	289	1997	84
3	104151	91863	99.22	807	272	596	50
1 late	66756	51722	77.47	15034	8184	8848	1998
Checks	98952	68064	68.78	30888	20730	17988	7833

Comparative savings as a result of spraying 1909-11

TREATMENT	WORMY APPLES ELIMINATED		GAIN		END WORMY ELIMINATED		GAIN	
	No.	Bbls.	No.	Bbls.	No.	Bbls.	No.	Bbls.
1 spray	28150	70¼	.....	.....	20341	50¾	.....	.....
2 spray	28686	71⅝	536	1⅜	20441	51	100	¼
3 spray	30081	75	1395	2½	20458	51	17	1/16
1 spray, late	15854	39½	.....	.....	12546	31⅜	.....	.....

A study of the above data brings out the relative value of the various sprays in a somewhat different manner. Taking the check or unsprayed trees with their 98,952 apples or approximately 247¼ barrels as the standard, we find that one spraying in the first period reduces the number of wormy apples by 28,150 (70¼ barrels) or end wormy alone by 20,341 apples (50¾ barrels). The one late spraying three weeks after blossoming, takes 15,854 apples (39½

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barrels) from the wormy column and but 12,546 apples (31¼ barrels) from the end wormy. The two sprays, one given just after blossoming and the second about three weeks later, reduced the number of wormy apples by 28,686 (72½ barrels) and the end wormy by 20,441 (51 barrels). This latter is not very different from the returns given by the first timely application, and in connection with the data for one late spray, shows at once that the latter is comparatively inefficient, so far as controlling codling moth is concerned. The three treatments, one spraying just after blossoming, a second about three weeks later and a third the latter part of July, eliminate from the wormy column 30,081 apples (75 barrels) and from the end wormy 20,458 apples (51 barrels).

It will be seen by referring to the above tabulation that the second spraying resulted in a gain of only 1¼ barrels, while three sprayings produced an additional gain over the two of but 2¾ barrels or a total gain over that secured from one application, of 4¾ barrels. The one late spraying eliminated only 39½ barrels from the wormy column, a saving of approximately 4/7. The above comparisons are based on approximate yields of an equal number of trees, and in all instances except in the case of the trees receiving the one late application, the total product of each plot was approximately 100,000 apples or 250 barrels. The above tabulations all show that by far the greater benefit resulting from spray operations accrues from the one treatment given within a week or ten days after the blossoms fall, and that the gains following subsequent sprayings are relatively insignificant. We do not undertake to imply thereby that one thorough timely spraying will control the codling moth satisfactorily in all sections of the country, though we believe that the possibilities of one treatment have habitually been underrated.

Single spray experiments by others. It may be claimed by some that the above returns from one spray are exceptional and can not be duplicated under other conditions. Prof. A. L. Quaintance of the federal bureau of entomology has recently compiled figures showing returns from one application and experiments conducted by him in different states over a period of several years. He finds that the average of the percentages of sound fruit from one spraying is 90.64 as compared with 96.19, the average of the percentages of sound fruit on the demonstration plots receiving from three to five applications in one season. The unsprayed trees in his experiments give an average of 57.79 per cent of worm-free apples.

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He finds a considerably greater variation in the percentage of sound fruit from plots receiving one spraying than from those given three to five sprayings, this being particularly marked, as would be expected, under unusual seasonal conditions, such as injury to the fruit by hail storms. Substantiating this work of the federal bureau it is worthy of note that Professor Gossard of Ohio obtained 91.60 per cent of worm-free apples, while the check trees produced but 45.80 per cent of sound apples, and Professor Rumsey of West Vriginia, 97.40 per cent of worm-free apples (the unsprayed trees yielding only 65.9 per cent of sound fruit) as a result of one thorough spraying. These results are certainly not very different from those we obtained in the Hudson valley.

Both Professor Quaintance and Professor Rumsey also made observations upon the efficiency of this spray in the control of the plum curculio on apples, and Professor Quaintance summarizes the situation as follows: "It would therefore appear from the foregoing that for the control of the codling moth and plum curculio under eastern conditions a single thorough spraying is about as efficient as a schedule of treatment requiring three or more applications."

Control of the second brood. We have purposely emphasized the importance of thorough spraying within a week or ten days following blossoming, preferably in the earlier part of this period, because data available show that we must depend largely on this treatment for the control of the second brood of apple worms appearing the latter part of July, during August and September, and making small holes in the apples, especially where they touch each other or a leaf. Careful field studies by A. G. Hammer of the federal bureau of entomology showed that during 1909 second brood codling moth larvae at Northeast, Pa., began entering the fruit August 5th, were most abundant the latter part of that month and early in September, the last being observed about the 20th. Approximately the same conditions may be expected in western New York, though an abnormal season may result in the appearance of many young larvae unusually late, as appears to have been the case last fall in certain sections of New York State. These late appearing larvae should not be confused with the lesser apple worm, an insect recently discovered in the State and one comparatively harmless so far as we have been able to ascertain.

Referring once more to the comparative summary given above, an increase of 100 end wormy apples will be noted between plots

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sprayed twice and those sprayed once, accompanied by an increase of 562 side wormy apples; in other words, each apple worm successfully evading the first spray appears to have produced approximately 5.6 side wormy fruit later. Similarly, a difference of 217 end wormy and 1963 side wormy will be noted between plots sprayed three times and those sprayed once, there being a ratio of 1 to 9 between the increase of end and side wormy. Now, if we bear in mind the importance of the first application in reducing the end wormy (this comprises about two-thirds of the total wormy fruit on unsprayed trees) from 20.95 to .349 or .353 per cent (the former an average of three years' work with one spray, the latter the return from four years' work), we can hardly escape the conclusion that the very best way of controlling the second brood is to spray most thoroughly for the first. Some six years ago Professor Ball of Utah estimated that under conditions obtaining in that state, two sprayings during the first period mentioned above, namely, within a week or ten days after the blossoms fall, are worth six to sixteen times as much as three late ones. This ratio is approximately true for our conditions, though considerable variation may be expected from year to year. Checks in the fruit from hail storms, sun scald, or burning by insecticides or fungicides afford easy and safe points of entrance for second brood larvae and have a material bearing upon the production of sound fruit. All having practical experience with this pest know only too well how quickly the young apple worms take advantage of these opportunities. The development of such conditions as those just mentioned or the somewhat common occurrence of wormy apples in early July would be ample justification for a treatment the latter part of that month or early in August for the purpose of destroying second brood apple worms before they can enter the fruit.

Conclusions. A study of the data collected during the past four years justifies the conclusion for the Hudson valley at least, that in normal seasons when the crop is abundant or fairly abundant, one thorough early spraying within a week or ten days after the blossoms fall and preferably early during that period, should result in the production of 95 to 98 per cent of sound fruit. A slight gain will accrue from a second treatment about three weeks later, and additional returns may be secured from a third spraying the latter part of July. The benefit from the latter two is comparatively small, so far as the codling moth is concerned, though ample to meet the cost of the poison and, in many instances, probably the expense of

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treatment. There is no question as to the advisability of using poison in the later sprayings wherever there is sufficient fungous disease to warrant treatments for this purpose.

A small crop almost invariably means a larger percentage of wormy fruit, and if the prospects are even fair for good prices, the third spraying (the latter part of July) would at least justify itself because of the additional protection from possibly severe injury by the second brood. The treatment three weeks after the blossoms fall may be advisable, especially if the first application is not thorough for some reason or other.

Fungous diseases are of comparatively little importance in the Hudson valley. Many of our fruit growers have obtained fair results with one treatment, and the above data, we believe, show the reason why such is the case. Comparatively few have appreciated the importance of one thorough treatment at the proper time. With the information given above, we believe that our Hudson valley fruit growers can ascertain for themselves whether more than one spraying is advisable. There is no reason why the progressive fruit grower should not watch developments, and if wormy apples seem to be somewhat common in early July, protect himself against further possible injury by thorough spraying the latter part of that month and thus destroy many of the second brood larvae before they can enter the fruit. This supplemental treatment will hardly be necessary more than once in three or four years, unless a light crop and high prices justify efforts to produce the largest possible quantity of sound fruit. These results, while especially applicable to the Hudson river valley, should prove helpful in other regions, even though conditions may be somewhat different, since they emphasize the importance of thorough work during the first period. Other sprayings are more or less supplementary in nature and their relative value should be clearly recognized by the orchardist.

HESSIAN FLY

Phytophaga destructor Say

There is perhaps no important insect pest where nicer discrimination and a closer balancing of varied factors is necessary to the production of a profitable crop than in the case of the Hessian fly. This pest is very susceptible to climatic conditions; dry weather results in long periods of practical inactivity, while rains and the accompanying succulent growth are most favorable to the pest.

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The character of the soil, drainage, fertility and tilth, the variety of wheat and the time of sowing all modify injury by this tiny midge with its remarkable adaptability.

The truth of the above was abundantly evident during the extremely severe outbreak of 1901 and the less extended damage of the past season. The wet spring of 1912 resulted in succulent growth most favorable for the development of maggots. To make matters worse, dry weather at the time the preceding crop was harvested, promoted shelling and subsequent moisture resulted in abundant volunteer wheat and a resultant large fall brood of flies, the descendants of these causing most of the injury in 1912.

Signs of infestation. The first indication of attack is found in the darker color of the leaves and a tendency among the young plants to stool freely. The broader lower leaves and the absence of a central shoot, it having been killed, are also characteristic of infested fields. As the attack advances the affected plants turn yellow or brown and die, and the maggots may be found at the base of the leaves near the ground. The spring brood attacks tillers or laterals which were unharmed in the autumn, dwarfing and weakening the stem so that the grain usually lodges before ripening or else fails to develop fully.

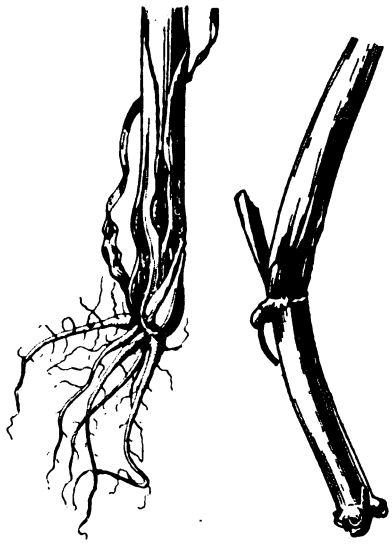


Fig. 1 Base of infested wheat stem showing "flax-seeds" or puparia under the leaf sheaths (original)

Causes of the outbreak. Extreme dryness at the time of the wheat harvest in 1911 promoted shelling and resulted in an unusually large crop of volunteer wheat, which latter was greatly favored by late summer rains. Reference to the weather reports of this locality shows that in July 1911 Le Roy was favored with a precipitation amounting to 2.86 inches, most of this occurring between the 15th and the 25th. There was an additional precipitation of nearly an inch in early August, followed by almost three-fourths of an inch in mid-August and nearly two inches the latter part of that month, while in September there were nearly three inches in the early part of the month and at least fair rains near the

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middle and the latter part, the total for September amounting to 4.39 inches. Such conditions are obviously well adapted to the early starting and vigorous growth of volunteer wheat and would result in the production of an abundant succulent tissue and thus produce a condition almost ideal for the development of this pest. There may easily have been a supplemental brood on many areas prior to the appearance above ground of the regularly sown wheat. This extra brood would mean a more severe infestation in the fall and consequently serious damage in the spring. It would appear as though the elements had combined to bring about an abundant crop of volunteer wheat, practically an extended sowing of a trap crop, which latter had not been plowed under early enough so as to destroy the pests and prevent further damage.

Losses in 1912. Winter injury should not be overlooked at the outset. Mr F. C. Walker of South Byron stated that ice remained on some of his fields from February through March and killed most of the grain. The writer saw many low wet spots throughout the region where grain had evidently been killed during the winter. Some growers held winter injury responsible for from one-half to all the loss. The writer is hardly prepared to accept such a high estimate for sections where the Hessian fly was rather numerous. There were places where this insect was abundant and its presence practically ignored. Severe damage appeared to be confined largely to Genesee county, though reports of injury were received from Livingston county, and the pest was observed somewhat abundant in Orleans county. We are unable to learn of extended injury in Erie or Niagara counties, including sections severely affected in 1901.

Erie county. At East Lancaster and east of Crittenden a very poor stand of wheat was observed from the train. Mr Gilbert Ayers of the latter place considers winter injury to have been responsible for most, if not all the damage.

Genesee county. Mr W. E. Harding, of Linden, reports, under date of July 3d, that at first he was inclined to believe there was no injury, but on further investigation learned that there was considerable damage. Later he estimated the crop for 1912 at 13 bushels an acre, the normal yield being 25 bushels, and stated that over 90 per cent of the fields were infested. He estimated the loss in the town at 40 per cent at least, and adds that one field of six acres showed no injury by the fly, though it was seriously damaged by ice and water, while in another of seven acres the yield was

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cut down 15 per cent by the Hessian fly and there was practically no injury by ice. Mr R. H. Hill, also of Linden, placed the yield at 15 bushels an acre, the normal yield being 20 bushels and the percentage of infested fields 75. He estimated the loss at 25 per cent.

Mr William Embt, of Linden, estimates the yield at 13 bushels an acre, a marked contrast to the normal yield which he places at 27 bushels. He states that all the wheat in that section was infested and estimates the loss at $20,000.

Mr J. Lathrop, of Morganville, under date of June 24th, reports the wheat crop as an entire failure in that vicinity, on account of the extreme cold weather of last winter when the fields were covered with ice, the little wheat escaping winter killing being damaged by the Hessian fly. There appeared to be no exemption as to variety or time of sowing. Later, Mr Lathrop states that from 34 acres of wheat he obtained only 115 bushels of grain and adds that the yield for the year will not be above 6 bushels an acre, the normal being 20. He estimates the loss for the town at 46,600 bushels and states that all the fields were infested.

Mr John R. Simmons, of Morganville, placed in mid June the loss at from one-half to three-fourths of the crop, number 6 and Klondike being the varieties affected. He estimates the yield in Genesee county at no more than 5 bushels to the acre with a possibility of total failure.

Mr C. N. Green, of South Byron, reported the yield at 8 to 10 bushels an acre, the normal being 20 to 25 bushels. He states that 80 per cent of the fields were infested and adds that their greatest trouble was not with the Hessian fly but the hard winter. He is of the opinion that if the wheat had come through the winter in good condition it would not have been destroyed by the fly.

Mr G. W. Miller, of South Byron, placed the loss the latter part of June at 60 to 75 per cent, the white wheat (number 6) being the variety affected. There was not, in his estimation, any apparent restriction of injury due to the character of the soil or the elevation. The latter part of September he estimated the yield at 8 bushels an acre, the normal being 20, reported 100 per cent of the fields infested and a loss for the town of 50,000 bushels.

Mr J. F. Rose, reporting in early June, estimated the injury at 25 per cent, all kinds being affected, though number 6 suffered most. The date of sowing apparently had no influence on the amount of injury. In September Mr Rose placed the yield at from

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1 to 2 up to 20 bushels an acre, an average possibly of 8 to 10, the normal yield being 25 to 30. He reported all fields as being infested and estimated the loss at 25,000 bushels.

Mr H. W. Tyler, of South Byron, in early July estimated the injury at 20 per cent, which he found was confined mostly to number 6 and Klondike. He states that the injury was less apparent on the better soils. The latter part of September he reports a yield on his place of 16 bushels an acre, the normal being 30, and adds that 99 per cent or more of the fields were infested. He is of the opinion that the reduced yield was due as much to winter injury as to fly and estimates the average yield for the locality the past season at 10 bushels an acre.

Mr F. C. Walker, of South Byron, reported the yield the latter part of September at 8 to 10 bushels an acre, the normal being 25 to 30, and adds that 99 per cent of the fields were infested. In his judgment, only half a crop was secured and he states that the dry season of last year resulted in an abundant shelling and a large amount of volunteer wheat, in which latter the Hessian fly probably bred abundantly last fall.

An examination by the writer of a number of fields in Byron the latter part of June showed an extremely poor stand of wheat. Many had been plowed prior to our visit, while the grain in others would average only from 10 to 50 per cent of what it should, and of this more or less was liable to lodge or fail to produce a full crop. The large field belonging to Mr F. C. Walker was apparently looking well, yet an examination resulted in finding many infested stalks which will either fail to produce full heads or else are very likely to lodge. The wheat field of Mr C. N. Green was one of the best examined and yet there was a probability of a reduction of from 25 to 40 per cent in the crop.

Livingston county. John McNaughton, of Caledonia, placed the loss the latter part of June at from 10 to 20 bushels an acre, all varieties in his section being affected. No subsequent report or additional data have been received from this county.

Monroe county. Observations from the train and near Churchville and at Cold Water showed several very poor fields, most of the injury being due to winter killing though some may have resulted from attack by Hessian fly.

Niagara county. Mr Ralph Darrison, of Lockport, stated that he had talked with several farmers and none reported trouble with the Hessian fly.

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Onondaga county. Mrs A. M. A. Jackson, of Warner, finds little evidence of the fly and no serious injury. We have been unable to learn of material loss in this county.

Orleans county. An examination of local wheat fields showed that from 25 to 75 per cent of many had been destroyed, 5 or 6 puparia being found at the base of some stalks. There were in these fields some rust, some smut and undoubtedly winter killing in low places. The latter was held by some to be responsible for most of the injury, though we are of the opinion that the work of the Hessian fly was greatly underestimated. Several poor wheat fields were also observed in Orleans county east of Albion, some of the damage, as in other places, being undoubtedly due to winter injury.

Mr Clark Allis, of Medina, reports some fields of wheat as being hardly worth harvesting on account of winter injury rather than damage by Hessian fly. We saw no evidence the latter part of June in that section of serious damage to wheat by insects.

Ontario county. Mr W. T. Case, of West Bloomfield, reports wheat "used up" in the western part of the county and much damage to barley. He can recall but one other occasion when it was so bad as this year though a few fields of Dawson's golden chaff escaped and produced a good crop.

Seneca county. Mr M. C. Brokaw reports in June the appearance of Hessian fly in gold coin wheat and adds that he is unable to estimate the damage due to insects and that wheat at best will make only a fair crop. Mr B. R. Hewlett, of Interlaken, estimates the yield at 20 bushels an acre, the normal being 30, and the percentage of infested fields ranging from 10 to 27.

Wayne county. Mr E. W. Catchpole, of North Rose, states that there was not enough wheat grown in that section to give a satisfactory estimate, though the injury was variously placed at 10 to 15 per cent more than usual.

Wyoming county. Mr P. A. Kemp, of Wyoming, states that the Hessian fly has caused considerable damage in the town of Middleburg, the most of it apparently being confined to the portion bordering on Bethany in Genesee county. He adds that Messrs A. C. and N. M. Ewell estimate the loss in Middleburg at several thousand dollars. These gentlemen, in a later communication, place the yield at 10 to 20 bushels an acre and the loss at 5, the normal being 20 to 25. They estimate that 75 per cent of the fields were infested and the loss at 33⅓ per cent. Some wheat fields appear

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to be somewhat more seriously damaged than others. Mr Henry D. Flach, of Attica, reports considerable damage in that section of the county though not all fields were injured; the loss in some amounted to 30 per cent.

Food plants. The Hessian fly was early recognized as a pest of wheat, rye and barley, and despite the fact that there are occasional records of its occurrence in timothy and other grasses and grains, there is no authentic evidence of its living in anything else except the grains named above and quack or witch-grass, Agropyron repens. This restriction in food plants is of considerable importance, since it materially simplifies the problem of control.

Life history. There are two generations in this latitude normally, though supplemental ones may occur. The adult fly deposits from 100 to 150 eggs, according to Marchal, placing them between the ridges on the upper surface of the blades of young wheat. Midges of the spring brood occasionally thrust their eggs beneath the sheaths of the lower leaves.

The flies may occur any time after wheat is up and possibly *between* killing frosts. The eggs hatch in about four days and the maggots then make their way down the leaf to the base of the sheath. They do not burrow but lie next the stem and absorb nourishment from the adjacent soft tissues which gradually become depressed and give way as the insect develops. The maggots are usually found in the fall close to the roots of winter wheat and at or beneath the surface of the soil, while in the spring they are more common about the second or third joints. The larval transformations occupy about twenty days, though their duration is much affected by weather conditions. The length of the pupal stage is exceedingly variable and greatly modified by the precipitation. Cold or heat and dryness tend to lengthen, and heat and moisture to shorten the duration of the different stages, especially the pupal. The winter is passed in the flaxseed or pupal stage, the spring brood of flies emerge in April or May and in turn deposit eggs on the more luxuriant leaves and another life cycle may be completed in about thirty days.

Number of generations. The short life cycle permits a number of broods in one season and apparently there may be as many generations as weather and food conditions permit. We may expect constant breeding during the growing season if continued damp

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weather enables wheat, barley and rye to grow luxuriantly. During midsummer, as a rule, only a little volunteer wheat is in a condition for the larvae to live on, though this was very different with barley in 1901, when continued moist weather, after the spring brood had developed to pupae, brought out hosts of flies. Eggs were laid in large numbers in the barley, especially the late sown, and in early July many fields in Genesee county were badly infested. The maggots were near the ground in the latest barley, and in that early sown occurred 10 to 12 inches above the surface, showing that the insect lives by preference in soft growth and inferentially that it thrives only indifferently in the older, harder growth. The relation between a rank, succulent growth and injury was further shown in a hilly patch of wheat. The grain on the gravelly, comparatively dry knolls was nearly immune, while in the more moist gullies the stalks of wheat were very scattered. The resistance of so-called "fly proof" wheats depends in large measure upon the relative hardness or maturity of the stalks at the time the flies appear and deposit eggs.

Emergence of flies. This is an exceedingly important matter because successful methods of preventing injury depend upon a correct understanding of the habits of the flies. The flight of the Hessian fly is dependent on weather conditions. The following rules will assist materially in forecasting probabilities:

1 The flies may remain an indefinite period in the "flaxseed" or pupal stage during dry weather.

2 "Flaxseeds" or pupae are very likely to develop flies in large numbers during damp, warm weather.

3 Adults are killed by heavy frosts though this is not true of larvae and "flaxseeds" or pupae, and hence flies may appear and deposit eggs *between* killing frosts.

4 Under certain conditions some of these insects may spend nearly a year in the flaxseed stage.

5 Recently emerged flies must, in all probability, deposit eggs shortly upon succulent grain.

The above rules show that egg-depositing flies may appear at any time during the growing season, provided weather conditions are favorable, though naturally we would expect them to issue in large numbers only at the first favorable period after a large brood had attained the "flaxseed" or pupal stage. Thus, as our springs are usually warm and moist, this means that ordinarily most of the flies will emerge the latter part of April or early May. Then

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there must be a sufficient period for the completion of a life cycle before another brood of flies can appear, and if at that time and for a considerable period thereafter the weather be hot and dry, comparatively few or no flies will appear till conditions change.

We know that early sown wheat is very apt to become badly infested in the fall, while late sown grain frequently escapes. In the first instance the young wheat is in a succulent condition and receives a deposition of eggs before or between killing frosts, while in the other case it escapes. If the flies emerge early and there is no grain available, the most of the insects perish and the infestation is very slight or negligible. Weather conditions must always be considered in sowing winter wheat. The general rule may be stated as follows: Moist, warm weather in early fall will permit the safe sowing of wheat at a relatively early date, but when the fall is dry delay sowing till the latest possible date. The normal or average date when wheat can be sown in New York without danger of its becoming infested with Hessian fly is about September 20th.

Parasites. The parasites of the Hessian fly are of much value in controlling this pest. The easiest way to determine the parasitism in a field is to take infested stalks and rear the insects. A net-covered jelly tumbler or fruit jar, taking care to avoid close covers and the resulting molds, will answer very well as a breeding cage. An examination of the "flaxseeds" late in the season after the parasites have emerged under natural conditions will give some idea of the relative numbers which have been killed by these beneficial insects. Sometimes fully 90 per cent are destroyed by parasites, and occasionally entomologists have experienced difficulty in obtaining midges from infested wheat because parasites were so abundant.

A representative sample of infested wheat was taken from the field of Mr F. C. Walker, of Byron, and the insects reared. It was found that 119 puparia were parasitized, 11 diseased and 37 in a normal condition. In other words, 70 per cent of the "flaxseeds" were parasitized, 8 per cent diseased and less than 12 per cent were in a condition to produce flies. The two most abundant parasites were Merisus destructor Say and Tetrastichus carinatus Forbes, numerous samples of both being reared. In addition, one specimen of Eupelmus allyni French, a species of Tetrastichus, one of Callimone, one of Pleurotropis and a Pteromalid were obtained. These determinations were made by Mr J. C. Crawford through the courtesy of Dr L. O. Howard and

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are interesting since they show just what forms were present in the wheat fields last summer.

In addition to the parasites mentioned above, there is a wingless species known as Boeotomus subapterus Riley, which was not obtained and appears to be exceptionally efficient in Missouri. Platygaster herrickii Pack. is recorded as a common parasite and a European species, Entedon epigonus Walk., should be of assistance in checking this pest. Peromalis pallipes Forbes is another species which preys upon the Hessian fly.

An abundance of parasites means very few midges later and comparative immunity from injury in all probability. Wheat stubble or chaff containing numerous parasitized "flaxseeds" should never be burned, since this may result in more real damage than if nothing be done.

Preventive and remedial measures. *Late sowing.* The most important preventive is to delay sowing till after the flies have deposited their quota of eggs and perished. This means in New York State delaying sowing, as a rule, till September 20th or a little later. It will be seen by referring to a preceding paragraph that the precipitation in August and September may have an important influence in determining the time when the flies will appear. Rains in late summer and early fall mean an early emergence of the flies, and if the moisture does not come too soon, a correspondingly early disappearance. Should the rains be early enough to permit the development of a supplementary brood on volunteer plants before the main wheat crop is up, there may be a large increase in the number of flies attacking the grain. It requires, under the most favorable conditions, only about 30 days to produce a generation, hence this danger is far from theoretical.

Resistant varieties. Experience in 1900 and 1901 in western New York showed that varieties such as number 8, Dawson's golden chaff, white chaff, Mediterranean, red Russian, prosperity and democrat withstood attack very successfully, while the beardless, weak-stemmed white wheat known as number 6 was very seriously injured and, in many cases, totally destroyed. Resistance is only comparative and a wheat immune in one locality may be rather seriously affected in another. The only safe way is to sow resistant varieties even though the non-immune wheats are better producers.

Good culture. Culture counts for much in growing a good crop of wheat. The field should be thoroughly prepared and the land put

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in excellent condition before sowing. The aim should be to produce a growth of firm straw and plants vigorous enough so that if attacked they will tiller abundantly and thus prevent a serious decrease in yield. Badly drained soil with its accompanying succulent weak growth appears to be quite favorable to the fly.

Trap strips. There is no question as to the value of trap strips, especially in seasons when the Hessian fly is excessively abundant. This pest becomes numerous only when conditions are favorable, and it should not be difficult for the well-posted wheat grower to anticipate, in considerable measure, the probability of injury and to judge as to the desirability of sowing trap strips. These latter should be sowed early (approximately August 25th to September 10th in New York State) so as to attract the flies and induce the deposition of eggs before the main crop appears above ground. The infested wheat should then be turned under deeply so as to prevent the subsequent development of the insects. It is not necessary to have the trap strip on the sides of the wheat field, though such a location is preferable, as the chances of attracting most, if not all the flies, are better.

Burning stubble and chaff. The burning of stubble has been recommended by a number of writers, but in New York State at least, the common practice of seeding with wheat makes this inadvisable. Such an objection would not hold in regard to burning chaff from the thrashing machine and this might well be done in case the wheat is at all infested by the Hessian fly. This measure would also prove of service in controlling the allied wheat midge.

Plowing under stubble. The early plowing under of infested stubble before the flies emerge is advisable if it can be done without additional expense.

Destruction of volunteer wheat. This latter is a prolific source of breeding in some seasons and should be turned under wherever possible before the flies appear. In some instances it might be feasible to use a portion of the volunteer wheat as trap strips.

Rotation of crops. This is excellent agricultural practice and should be of service in reducing ravages by the wheat midge, especially if care is taken to locate the wheat fields of successive years at some distance from each other.

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A detailed account of this insect, with an extended bibliography is given in the report of the Entomologist for 1901 (N. Y. State Mus. Bul. 53) pages 705–30. The more recent literature has been listed by Paul Hayhurst in the Journal of Economic Entomology, 1909, 2:231–34.

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FALL ARMY WORM

Laphygma frugiperda Sm. & Abb.

This sporadic pest attracted notice the past season for the second time in recent years on account of injury by the larvae to lawns. The earlier outbreak occurred in Buffalo in 1900, the caterpillars destroying the grass of lawns by cutting it off just below the ground. Several reports of injuries to lawns were received last fall from persons in New York City, while Mr Roy Latham, of Orient Point, stated that the caterpillars were very abundant under date of September 11th, occurring in corn, Hungarian and wild crab grass. The latter he considered a source of the pest and stated that acres of lawn and Hungarian had been ruined. The last part of September he reported thousands of caterpillars on corn, there being at that time many very young ones.

Characteristics of outbreaks. The work of the fall army worm is most easily recognized because it usually occurs much later than that of the true army worm. It feeds by preference upon a variety of grasses and, under certain conditions at least, seems to display a marked preference for lawns. This latter habit has not only been observed in New York State but also in Illinois and West Virginia. The caterpillar responsible for this trouble is smaller and more slender than the true army worm, Heliophila unipuncta Haw., and is peculiar in the somewhat narrower, nearly black head with a more or less distinct, inverted, Y-shaped mark in front bordering the eyes and extending down to the mouth-parts.

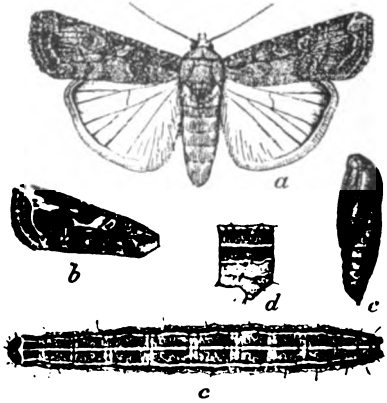
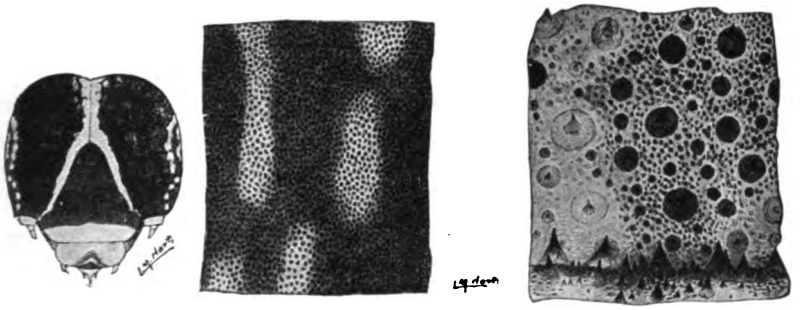


Fig. 2 Fall army worm. *a*, Moth, the plain, gray form; *b*, forewing of mottled form; *c*, larva extended; *d*, abdominal segment of larva; *e*, lateral view of pupa; *d*, twice natural size, others enlarged one-fourth. (After Chittenden, U. S. Div. Ent., Bul. 29, 1901)

Description. The moth is allied to that of the true army worm, Heliophila unipuncta Haw., though quite different in coloration, since there is no minute, white spot on the forewings. These in the fall army worm are rather dull grayish brown, with indistinct, oval, lighter markings as illustrated in the accompanying figure.

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The full-grown larva, as stated above, resembles that of the true army worm and may be best distinguished therefrom by the narrower head with its inverted Y-shaped mark well shown in the accompanying illustration.



a *b* *c*

Fig. 3 Fall army worm. *a*, Head of larva; *b*, *c*, surface of larval skin showing microscopic markings. (After Forbes, 23d Rep't, Ins. Ill. 1905)

The following descriptions of a half-grown larva and a full-grown one were drafted from living material.

Larva, half grown. Length one-half inch. Head shining black dorsally, the genae yellowish; clypeus fuscous yellowish and bordered on each margin by a distinct whitish line which is produced posteriorly over the head and forms a well-defined median line extending nearly to the posterior extremity. Labrum yellowish, labial palpi dark brown, antennae short, dark. Cervical shield shining black with distinct median and sublateral white lines. Body with the dorsal submedian areas a variably mottled chocolate brown and yellowish brown. This area is margined by a yellowish white lateral line. Laterally there is a broad stripe of dark chocolate brown variably marked with whitish and light brown and margined ventrally with a yellowish white stigmatal line. There is an indistinct substigmatal line, the substigmatal and ventral area being a variable yellowish brown; dorsally and laterally there are the usual series of large, shining, dark brown spiracles bearing short, black hairs; suranal plate shining black; truelegs shining black, prolegs fuscous yellowish.

A lighter specimen of about the same size, evidently recently molted, shows little of the characteristic markings described above, the head being yellowish transparent, the cervical shield and tubercles mostly light brown. The lighter longitudinal lines are only faintly indicated.

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Full-grown larva. Length one and one-half inches. Head dorsally, yellowish, obscurely mottled with dark brown, the genae light brown, with irregular fuscous markings; clypeus fuscous yellowish, margined with a dull white which is produced posteriorly as a median line; labrum brownish transparent. Antennae light brown, prothoracic shield mostly dark brown, variably mottled with fuscous yellowish and with whitish median and sublateral lines. General color of the dorsal surface of the body a light brown variably and obscurely mottled with fuscous yellowish, the median and sublateral dull whitish lines rather obscure, the tubercles large, dark brown and the suranal plate mostly greenish yellow, the setae short, stout, fuscous, the lateral stripe a variable dark brown mottled obscurely with yellowish and reddish and margined ventrally with a broad, irregular, dull whitish stripe with distinct reddish mottlings; ventral surface mostly yellowish green, in some specimens the greenish predominating, variably mottled with yellowish white; truelegs mostly pale yellowish, apically reddish brown, prolegs pale yellowish green.

Another larva presents the same general appearance, differing mostly in exhibiting indistinct, submedian, purplish stripes about half the width of the lighter dorsal stripe described in the preceding form. The lateral area is also somewhat darker and more distinct.

Another light colored larva shows a distinct dominance of green in the thoracic and anterior abdominal segments, the dorsal and lateral lines hardly showing.

Detailed technical descriptions of the egg and larva have been given by Mr Chittenden in Bulletin 29, n.s., Division of Entomology, United States Department of Agriculture, pages 16–18, 1901.

Food plants. The original food plants of this species are with little question various grasses. The caterpillars display a marked preference for our small grains, such as wheat, rye, oats and millet, and are frequently abundant in some other field crops, such as alfalfa, clover etc., the injury to the different plants depending somewhat upon their immediate availability; that is, the outbreaks by the fall army worm undoubtedly, as in the case of the true army worm, begin with certain foci determined probably by the deposition of a considerable number of eggs upon preferred food plants. It is inevitable, when the latter are devoured, that the larvae should spread in the search of additional provender, and with such a general feeder as this species, there is usually comparatively little difficulty in securing something palatable and, as a consequence, severe injury may be inflicted upon a considerable variety of plants.

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An examination of available literature shows that this species has been recorded as subsisting upon the following plants: alfalfa, apple, asparagus, barley, buckwheat, beans (velvet), cabbage, chick-pea (Cicer arietinum), clover, cockle-bur, corn, cotton, cow-pea, cucumber, grapes (gnawing stem and causing dropping of fruit) grasses (blue, Bermuda, creeping-bent, crab), hollyhock, kale, lamb's quarters, millet, oats, orange, peach, peas, pigweed, potatoes, purslane, rice, rye, sorghum, spinach, sugar beet, strawberries, sweet potatoes, Teosinte (Euchena mexicana) tobacco, tomato, turnip and wheat.

Life history. The life history of this insect has not been thoroughly worked out, though we know that several generations may occur in one season, that larvae are more likely to be injurious in the late fall, and that moths may be easily reared from such larvae. Adults were obtained the latter part of September or early in October from caterpillars transmitted to the office about the middle of September. Doctor Chittenden is of the opinion that the insects probably hibernate as pupae, with a smaller percentage possibly wintering as moths. He considers that all egg masses deposited late in the fall produce larvae, only a few of which may survive the winter. Transformation to the pupa occurs in oval cells from a quarter to not more than an inch and a quarter below the surface. Doctor Forbes observed three successive generations in central Illinois. This insect is a southern form, probably migrates northward annually, and may be unable to survive the climatic extremes of its more northern habitat.

Distribution. This species has been recorded from Maine to Kansas and Nebraska and even California, and is more abundant in the semitropical portion of the United States. It is a native of both North and South America, ranging from Brazil across Central America to the West Indies and must be regarded as normally a subtropical form.

Natural enemies. The caterpillars are preyed upon by various birds, there being records of sparrows and flickers feeding upon the pests.

The red-tailed Tachina fly, Winthemia quadripustulata Wied., is well known as a parasite of this species as well as of the caterpillars of the true army worm. An allied form, Frontina frenchii Will., has also been reared and there are several records of Hymenopterous parasites of doubtful identity living at the expense of this caterpillar. Chelonus texanus

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Cress., interesting because of its ovipositing in the egg and the parasite developing in the larva of its host, is a very efficient check in the Southern states at least.

Ground beetles, especially species of Calosoma, undoubtedly feed upon the caterpillars, one of the common and efficient forms being the fiery ground beetle, C. calidum Fabr.

Remedial measures. The adoption of preventive or remedial measures must depend very largely upon conditions. Restricted outbreaks upon lawns can doubtless be controlled most efficiently by early and thorough spraying with an arsenical poison, using about 2 pounds of arsenate of lead (15 per cent arsenic oxid) to 50 gallons of water. If there are local reasons why a poison of this character should not be employed, many of the caterpillars could doubtless be destroyed by liberal, and if necessary, repeated applications of a kerosene emulsion, the standard formula diluted with 9 parts of water. It would be well if this latter were employed on lawns, to follow the application of the kerosene emulsion with a copious drenching of water. In some instances the use of a poisoned bait such as succulent clover dipped in Paris green water, or even a poisoned bran mash may be advisable. These latter, if used, may well be distributed just before dusk in order that they may remain fresh and attractive for the longest possible time.

Invasions from adjacent fields may be prevented by the use of mechanical barriers such as furrows, boards with strips of tar and other means employed for checking similar movements of the true army worm caterpillars.

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ELM LEAF BEETLE

Galerucella luteola Müll.

The season of 1911 was marked by exceptionally severe and widespread devastation by the elm leaf beetle. The damage was so serious that elm-shaded communities were most easily recognized in midsummer by the brown, dead foliage. The same condition prevailed in many roadside groups of trees. Numerous elms, unable to produce a second crop of leaves, had no opportunity to recuperate before the rigors of winter still further reduced their vitality. Some died while many others put forth a feeble leafage in 1912 only to have that nearly destroyed by midsummer. These trees are now in an extremely weakened condition and many may succumb during the winter. The tall elms with few branches and deficient foliage are the first to show the effects of elm leaf beetle attack. Moreover, they were not so easily protected by spraying

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and should therefore receive special attention if it is desirable to preserve them. The range of this pest is still extending as shown by the receipt of specimens from Ellenville and Gloversville, localities not previously known to be infested.

Beetle work in 1912. The season opened with every indication that extended and severe injury would result. Numbers of the beetles began feeding early and on June 5th their work on elms at Nassau was much more conspicuous than it had been for some years. Many of the leaves on the lower branches were badly riddled and those in the tops of the trees showed no perforations. The indications then were favorable for exceptionally severe damage. Egg masses were just being deposited, those observed being moderate to large size and containing from five to about thirty-five eggs. A period of relatively cool weather occurred the second week in June. The official records of the weather bureau state that in New York lower temperatures were recorded during that month than any previous June since the weather service was established. The maximum temperature at the Albany station dropped from 80° to 85° F. during the first few days in June to 70° and even 63°, the minimum falling as low as 41° on the 8th. Our studies of this insect in 1898 show that this markedly cool weather came at about the beginning of the ten-day period when the beetles should deposit approximately half of their entire quota of eggs. As a consequence of these abnormal conditions, oviposition was checked and the hatching of eggs greatly delayed with a corresponding backwardness in the feeding of the grubs. An examination of conditions at Nassau on June 24th showed that comparatively few egg masses had been deposited and there was little evidence of work by young larvae. Only a few about one-quarter grown were discovered. The same conditions appeared to prevail in Albany and up to that time, so far as our observations went, comparatively few eggs were found. On July 3d most of the grubs on Manning boulevard, Albany, were only about one-quarter grown, a few being half grown. On July 7th a few full-grown grubs were observed at Nassau, though a number of smaller larvae were still feeding. At Mount Vernon many grubs were only half grown July 10th, though pupae were rather numerous on a few trees and some recently transformed beetles were observed.

The season was also peculiar in the uneven character of the injury. The elm leaf beetle is well recognized as a local species. The season of 1911, as stated above, was marked by an unusually

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widespread defoliation. The beetles appeared to winter in excellent condition and one would expect similar general injury the following year. There was severe damage in 1912 in most localities where the beetle was very injurious the preceding year, but it was much more restricted and was not readily explainable by any local conditions. Some trees had the foliage practically skeletonized while others, though unsprayed, were but slightly damaged. A portion of this sporadic injury is doubtless explained by spraying or the lack of it, though even this factor does not account satisfactorily for all cases. The relative vigor of the trees also had an influence as pointed out above.

The elms of Catskill were very badly affected, especially just west of the main business street and particularly in the vicinity of the court house on Broad street and at the corner of Williams and Spring streets. Some of the trees were nearly bare July 19th, others had over half the foliage, while the remainder of the leaves were brown and nearly lifeless. Here and there elms could be seen which were in a fairly good condition. Some of these, we were informed, had been sprayed. There was comparatively little injury at a distance from the business center. The above was one of the most striking instances of damage observed the past season. At Mount Vernon a number of trees had brown, dead foliage, and the same was true of other communities in that general section, such for example as Tarrytown, Port Chester and New Rochelle. There was more or less injury here and there in cities and villages along the Hudson valley. There was rather severe injury in the village of Kinderhook, due to no spraying, and the same was true, though to a less extent, of the trees on the side streets of Lansingburg. There was mostly very severe injury to the elms at Valley Falls and some scattering damage to roadside and field trees.

The general condition of the elms at Hoosick Falls showed a marked improvement over that of last year, due largely to spraying. Elms which had been thus treated, whether on the street or on private grounds, were mostly in excellent condition, while the unsprayed trees on back streets, in back yards and especially in the section across the river from the main portion of the town, exhibited a marked contrast. The elms of Albany are in a much better condition than the preceding year, due to more thorough work in spraying. One of the perplexing elements of the situation is that many of the elms in Watervliet, though unsprayed, exhibit comparatively little injury. The trees of Mechanicville hardly show

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the effects of the beetle, and here, likewise, we were unable to learn of any spraying. Waterford elms, as a result of vigorous agitation, were sprayed for the first time this year and those treated show a marked benefit as a consequence. The elms of Stillwater were very severely damaged in 1911, and the past season injury was confined mostly to the outskirts of the village and to trees on private property, many having been sprayed as a result of an earlier agitation. The systematic spraying of elms has been continued at Saratoga and Glens Falls and, we have been given to understand, has been started in Fort Edward. The village of Ticonderoga sprayed its trees for the first time and those responsible for the work are convinced that it has been a material benefit.

Experiments with elm leaf beetle. It was thought that possibly a sweetening added to the poison might materially enhance its effectiveness, as has been reported for the related parent of the grapevine root worm, Fidia viticida Walsh. Small American elm leaves were sprayed May 15th with arsenate of lead (12½ per cent arsenic oxid) used at the rate of 4 pounds to 50 gallons of water, and other leaves were treated with the same poison to which was added a cheap grade of molasses used at the rate of 6 pints to 50 gallons of water. Another branch was sprayed with clear water, all being kept until the moisture had evaporated. The application was to the under as well as to the upper surface of the leaves, and in the case of the poisoned foliage at least, was rather abundant, though the amount present was not in excess of that frequently observed upon trees sprayed under field conditions. The application was made with a hand atomizer. Beetles which had been kept in a pasteboard box for the preceding five days were placed in jars with the above treated leaves at 2.45 p. m. These insects must have been moderately hungry and thirsty, though these conditions would hardly have been more severe than those obtaining in many houses where the insects winter. Four beetles were in each jar and for a time appeared well satisfied to walk about on the damp sand in the bottom of the jar, this being particularly so in the one containing leaves sprayed with sweetened poison. The sand was possibly a little more moist in the jar containing foliage sprayed with the unsweetened arsenate of lead and there seemed to be a little more poison on these leaves than on the others.

Arsenate of lead plain. One beetle dropped from the leaves at 3.45 and appeared sick, since it lay upon its back with spasmodic

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twitching of the forelegs. Another dropped at 4.30 and the remaining two at 4.50, all being dead the following morning.

Arsenate of lead sweetened. The first beetle dropped at 4.05 showing feeble evidences of life, a second at 4.45 and at 5 p. m. the other two were alive. The next morning a third was dead in the jar, the fourth remaining upon the foliage. It was alive at 10 a. m. May 17th and at 9 a. m. the 18th.

The insects confined in the jar with unpoisoned foliage continued in a vigorous condition till the 20th, even though the leaves were badly shriveled.

These experiments were duplicated, the only difference being that the sand was covered with blotting paper and the beetles placed directly upon the leaves at 2.15 p. m. May 16th.

Arsenate of lead plain. One beetle had dropped at 4.20, the others being alive at 5 p. m. The next morning another was dead, a second on the sand and moving a little, motion ceasing at 9.45. The last remained on the foliage and was alive on the 20th, being dead at 9 a. m. the 21st.

Arsenate of lead sweetened. At 3.30 p. m. one had dropped, at 3.35 another, and a third at 4.05, the fourth being alive at 5 p. m. and dead at 8.45 a. m. the following morning.

Two other beetles from the same lot as the preceding were put in a jar with a blotter saturated with the sweetened poisoned spray at 10.30 a. m. May 18th. They appeared to be imbibing the mixture and were found dead on the 20th.

The above experiments were conducted with beetles which had not fed since the preceding fall and were presumably very hungry. The results show that the insects succumb to poison quickly under such conditions, and that in some situations it may well pay to begin spraying as soon as the insects commence feeding, though it is doubtful if the results secured would warrant the general adoption of this plan.

Tests conducted by the writer over a decade ago showed that beetles collected from elm foliage and confined in jars containing leaves sprayed with poison, fed very little for a day or two, eventually being forced by starvation to devour the distasteful food, all finally succumbing within a week or two. These results are markedly different from those detailed above, and the experiments of 1899 were duplicated in part last spring and substantially the same data obtained. Arsenate of lead was used at the rate of 4 pounds to 50 gallons of water and the spray allowed to dry before

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the beetles were placed upon the leaves. There was very little feeding the first day, more the second and eventually the insects succumbed as recorded in 1899. The important point is that elm leaf beetles will feed upon poisoned foliage only when compelled by hunger and, as a consequence, thorough spraying is necessary if one would secure satisfactory results.

Results of spraying for elm leaf beetle in New York State. We have repeatedly stated that well-sprayed trees should keep their foliage green and vigorous throughout the season. Furthermore, trees weakened from injury by this insect should be able to regain their vigor in large measure. Systematic spraying for this pest has been in progress in some New York communities for over ten years, and it may be instructive to review the situation and see what has been accomplished. There is no question but that these annual applications have been of material service in protecting the trees. This is quite different from admitting that the spraying has in all cases been satisfactory. The defects in treatment as ordinarily practised were especially apparent in 1911, because the extreme drought of that season served to emphasize the work of the beetle and led many to question the efficacy of the application. The Entomologist at that time examined the trees in several communities and was forced to conclude that the unsatisfactory results were due to poor work. The foliage of many trees here and there and that of most of the lower branches were in relatively good condition, while numerous trees had much of the foliage badly browned, this being especially true of the upper branches in the taller trees. Too many have tacitly assumed that any kind of spraying would give results, whereas, as shown by experiments detailed above, nothing but the most thorough work will result in keeping the trees in full vigor.

The elm leaf beetle, as is well known, first became well established in the lower portion of the Hudson valley. There are a number of cities and villages in that section where elms, especially the Scotch and English elms, are conspicuous by their absence. A very large proportion of such trees have succumbed to this pest in the city of Troy since 1895. The writer has watched this process of destruction in Albany and vicinity for over fifteen years. The earlier portion of this period was marked by extensive local injuries to European elms which were subsequently approximated only in 1911 when the beetle was so generally destructive to American elms. It was a time when the necessity of spraying was

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not generally appreciated. Systematic work against this insect began in the city of Albany about 1900 and was shortly thereafter undertaken in Troy under private auspices. The spraying of earlier years was with a moderate power outfit and a nozzle which would throw only a short distance, consequently much climbing was necessary if the trees were thoroughly sprayed. The ultimate outcome was that most of the poison was applied to the foliage of the lower limbs, while the tops were nearly untouched, and in years when the treatment, for some cause or other, was so late as to be comparatively ineffective, most of the leaves were destroyed on many trees. Furthermore, there have been times when the application to the lower limbs, even when timely, was not sufficiently thorough. The result of this policy has been a progressive weakening of many trees with the death of numerous elms here and there. Practically all those affected should have remained in full vigor for a generation or two, aside from the relative few which may have succumbed to adverse urban conditions, such as leaky gas pipes, poor insulation of wires, the cutting of roots, etc. None of these trees can be replaced in less than twenty-five years and most of them represent active growth for half a century.

A clearer idea of the condition may be gained by a few concrete examples. A canvass of the trees in Washington park, Albany, in August 1911 showed that over ninety elms of the approximately 275 in that recreation area had been severely injured by this pest. The foliage of all these trees had been badly browned, many of the leaves had dropped or there was a considerable amount of dead wood. This was in a section where elms should find most satisfactory conditions for growth, aside possibly from a slightly polluted atmosphere. The area lying between the Capitol and Madison avenue, Eagle and Lark streets is another striking illustration of these unfortunate conditions. In June 1912 ten dead elms were observed on Hamilton street between Lark and Eagle streets, a distance of only five blocks. There were four dead trees on South Hawk street within two blocks of Hamilton street and four dead or practically dead elms on three sides of the block in which the Albany Medical College stands. The last named block appears to have been exceptionally unfortunate, since the preceding year three stumps of what were magnificent trees were to be seen on Lancaster street, and three similar ones just around the corner on Eagle street. Most of the elms noted above have perished as a result of repeated injuries by the elm leaf

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beetle. This wholesale destruction can hardly be characterized as less than inexcusable and, in the estimation of some, might well be termed criminal negligence. It should be stated that the above conditions are not representative of all sections of the city, though they are typical of certain regions and important in that they give a concrete idea of what may be expected in other communities if the elm leaf beetle is allowed to multiply unchecked or is fought in a more or less desultory manner. It should be further noted that the lamentable conditions on Hamilton street and vicinity, noted above, are in an area which has been sprayed more or less thoroughly, mostly the latter, we fear, for over a decade. This injury is not the result of one season's neglect but is the cumulative effect of severe injury, in spite of spraying for a series of years. We would also add in this connection that the spraying in Albany during 1912 has given materially better results.

The selection of a spray outfit for community work is a somewhat difficult matter. Elms, even large trees, can be thoroughly sprayed with a hand outfit, provided the pump is of a good type, there is plenty of hose, the tree is climbed and the distribution is thorough. Work with a hand outfit is slow, costly and can be recommended only when comparatively few trees are to be sprayed. There are a number of light power sprayers equipped with engines of 1½ to 4 or 5 horse power which have been extensively used in shade tree work. These are generally provided with plenty of hose and much climbing is usually obligatory, especially if a nozzle delivering a fine spray is employed. The latter is ideal, though on account of the large amount of labor necessary in order to bring the nozzle sufficiently close to the foliage, spraying in this manner is costly. This has resulted in the gradual change from the fine spray to the coarse spray, and from that to a modified solid stream and eventually to a solid stream. The latest development along this line has been the large outfit with a 10 horse power engine capable of delivering the insecticide at the mouth of a nozzle one-quarter of an inch in diameter or thereabouts at a pressure of 200 pounds. The nozzle generally used with this equipment is about six feet long and is capable of throwing the insecticide to the top of the tallest trees even when the operator is standing upon the ground. This outfit makes possible the very rapid treatment of many trees and greatly reduces the cost of application, which amounts to only ten to twenty cents a tree. Experience has shown that this high pressure stream breaks

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up into fine particles and gives a much better distribution than we would at first expect. More poison is used than with the smaller type of nozzle, and on narrow streets in particular, more or less drifting of the spray and consequent annoyance or even damage is almost inevitable. This can be mitigated to a considerable extent by skill on the part of the nozzleman. This type of sprayer was designed in particular for woodland work and is almost equally valuable on wide streets and park areas. Further experience is necessary before recommending it unqualifiedly for the average city street. A serious objection, especially in small communities, is the expense of the equipment, such an outfit costing about $1200. Some villages have partially solved the problem by using the lighter outfit and a smaller solid stream nozzle adjusted to the limited capacity of the engine. This arrangement reduces climbing greatly and, so far as tried, has given very good results.

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WHITE GRUBS AND JUNE BEETLES

Lachnosterna species

The extremely severe injury to grassland, corn, potatoes and strawberries last spring was, with very little question, the outcome of a great abundance of May or June beetles in 1911. The large, brown or dark brown, blundering beetles partly defoliated many forest trees and were so numerous then as to make nuisances of themselves by invading lighted rooms. The insects soon disappeared but evidently not till after millions of eggs had been deposited in the grasslands as shown by severe and extended injuries caused by the grubs. Collections made in May and June 1911 show that Lachnosterna grandis Sm., L. fusca Froh., L. hirticola Knoch and L. hirsuta Knoch were the species most abundant, while the usually rare Polyphylla variolosa Hentz. was reported very common at Schenectady.

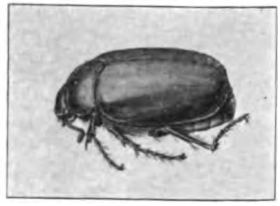


Fig. 4 A common May or June beetle, Lachnosterna fusca, natural size (original)

Characteristics. Our native species are brown or dark brown, stout beetles ranging from one-half of an inch long in L. tristis Fabr. to an inch long in L. grandis. Our more common form is L. fusca Froh., a species of average size and measuring about three-quarters of an inch in length. A study of this genus shows there is a large number of very similar species which are separable only with difficulty. The light brown Polyphylla variolosa Hentz. is more slender than the typical Lachnosterna and easily recognized by the light yellowish brown, irregular mottlings. A common and closely allied form is the spotted grapevine beetle, Pelidnota punctata Linn., easily recognized by its brick red color and the strongly contrasting six circular spots on the wing covers. The goldsmith beetle, Cotalpa lanigera Linn., is another allied form readily distinguished by its similarity in structure and the brilliant golden color. There

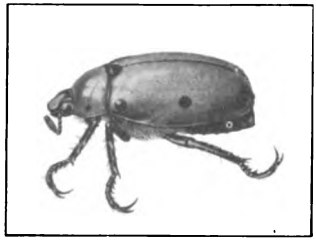


Fig. 5 Spotted grapevine beetle (original)

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is, in the southern part of the State, another ally of the June beetles known as the fig eater, Allorhina nitida Linn., peculiar because of its dull greenish color, the wing covers being usually margined with yellowish brown, and on account of the peculiar locomotion of the larvae; these latter turn on their backs and travel rapidly by a series of undulating movements which are made very effective by the short, stout dorsal spines.

New York species. The following species of Lachnosterna have been recorded from New York State: L. glaberrima Blanch., L. gracilis Burm., L. gibbosa Burm., L. crassissima Blanch., L. micans Knoch, L. fusca Froh., L. arcuata Sm., L. dubia Sm., L. grandis Sm., L. marginalis Lec., L. fraterna Harr., L. nova Sm., L. knochii Gyll., L. rugosa Mels., L. hirsuta Knoch, L. balia Say, L. nitida Horn, L. hirticula Knoch, L. ilicis Knoch, L. crenulata Froh., and L. tristis Fabr. That the above list is not exhaustive is evidenced by the thirty-one species recorded from New Jersey, presumably as a result of special collecting which has not been possible in this State.

White grubs. The term white grub is more than generic, since it is applied indiscriminately to a large number of Coleopterous larvae found under grass sod and in decaying organic matter. These larvae resemble each other in a general way and it is not surprising that they should be confused in the popular mind. The white grubs of the entomologist comprise an aggregation of forms normally living on grass roots and referable, as shown by rearing the adults, to several genera. Unfortunately, our knowledge of the immature stages is such that beyond a few general characteristics it is impossible to identify the various species of Lachnosterna as larvae. Large, stout, white, curled grubs, half an inch to an inch in length, with brown heads, and living on grass roots or those of closely allied plants in this latitude, are mostly referable



Fig. 6 White grubs in earthen cells (original)

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to the genus Lachnosterna. Even the recently hatched grubs present practically the same characteristics as the nearly full-grown individuals so numerous occasionally under sod which has been killed by these pests. The principal difference is that the smaller grubs are whiter, owing to the fact that there is proportionately less dark vegetable matter within the small body.

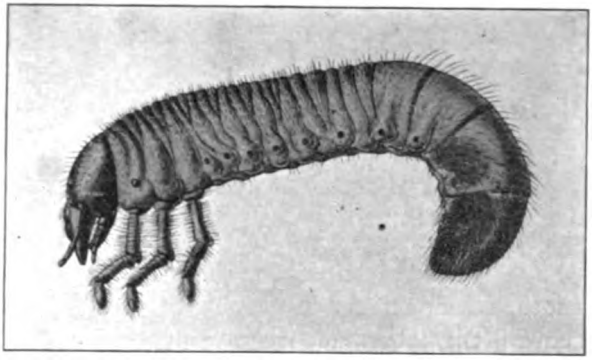


Fig. 7 White grub or larva of May or June beetle, enlarged (original)

Injuries in 1912. Many pastures and meadows as well as certain cultivated crops in Albany, Columbia and Rensselaer counties at least, were very severely damaged the past season by white grubs, and similar injury was reported from portions of Washington county. The pests were so prevalent in the southern part of Rensselaer county that most of the grass roots were cut off over considerable areas; in some instances grass on half an acres or even larger fields was totally destroyed, the sod being torn up wherever the horse rake was used. Such conditions were common in the towns of Schodack, Nassau and Kinderhook, to mention only a few localities where personal investigations were possible. Similar injury was reported by William H. Wanzer from Slingerlands near Hurstville in Albany county. The grubs not only devoured all the grass roots but frequently attacked those of nearby shrubs and trees, while rose bushes in one area were so badly eaten that the plants were readily torn from the ground. Mr B. D. Van Buren informs us that on his farm at Niverville the roots of a recently set apple tree were so badly eaten that it was easily pulled up. Corn planted on infested sod land was destroyed, and in one such locality a sample digging in October resulted in finding thirteen living grubs in an area of

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about one square foot, while we were informed that in July some boys collected over twenty grubs in one hill of corn. Adjacent to this area the pulling of corn stalks in the field resulted frequently in exposing two or three nearly full-grown grubs just at the base of a stalk and within an inch or two of the surface. Reports of injuries to strawberries and potatoes were also received.

An investigation of the damage in several localities showed that, as a rule, most of the injury was in spots where there was more moisture and presumably better grass. The affected areas were generally near the foot of a gentle rise and frequently in a small gulley. It appeared as though the beetles, when ovipositing in 1911, had been attracted to the denser patches of grass and oviposited therein very freely. In August many grubs were to be found just under the sod in cells one or two inches below the surface, as many as five to seven or eight occurring in one square foot. Investigation about the middle of October showed that comparatively few of the grubs were near the surface and that most of them were from seven to ten inches below. This was especially marked in grassland and by no means so evident in corn fields.

Life history. The extended life cycle of white grubs and the fact that a large proportion of their existence is subterranean, makes it very difficult to work out the life history of the various species in detail. This difficulty is further accentuated by the possible occurrence of several closely allied forms at the same time, the grubs being practically indistinguishable one from the other. The parent insects, as their common name indicates, appear in May or June and remain abroad about four weeks. The beetles feed upon the leaves of a considerable variety of plants and display a marked preference for poplar, willow, oak, chestnut, elm and apple, though they may also work upon the foliage of quite a number of trees and shrubs. The eggs, which hatch in about four weeks, are deposited in grassland, and in the case of the beetles appearing in 1911 there was an obvious selection of the richer, more luxuriant spots. The slowly developing grubs feed upon the roots of various grasses and allied plants. At the end of the first season the young grub may be only about a quarter of an inch long, while at the close of the second season the grubs are about a half to three-quarters of an inch long and present the familiar appearance of the depredator so commonly found at the roots of strawberry and other more highly prized cultivated plants. The grubs, whether small or large, burrow down into the earth on the

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approach of cold weather and remain until the following spring. In July of the third summer they construct oval cells and change to pupae, the latter transforming to beetles the following August or September and the perfect insects appearing during May and June of the next year.

Natural enemies. White grubs are most acceptable prey to pigs and also that much avoided and generally abused animal known as the skunk. Both dig in badly infested fields and swine are generally credited with being exceedingly efficient destroyers of these pests. They will frequently root up and devour practically all the grubs in badly infested areas to which they have access.

Crows are well-known enemies of the white grub. Mr William H. Wanzer of Slingerlands reported that in his locality these birds had discovered the infested areas and were digging out and devouring the grubs in grass and potato fields. Similar operations have been observed in Illinois, while studies by Dr F. E. L. Beal in 1894 showed that crows ate either beetles or grubs in every month from March to October inclusive. Blackbirds are also reported as feeding upon the grubs.

A common parasite of the white grub in Illinois is known as Tiphia inornata Say. The cocoon of this species is oval, brown and about three-quarters of an inch long. It is easily recognized by the slight neck or constriction at one extremity. These cocoons were found in small numbers in one infested field in Schodack. Another large parasite known as Myzine sexcincta Fabr. also preys upon the white grubs and forms a cocoon similar to that of the Tiphia noted above, though differing in their greater smoothness and lacking the loose, fluffy coating of silk. This species, according to recent investigations, appears to be fully as efficient a parasite as the Tiphia. Another parasitic Hymenopteron which has been reared from white grubs is Ophion bifoveolatum Brulle. The genus Ophion is rather common in New York State and there is no reason for thinking that other species may not prey at least occasionally upon the white grub.

A number of parasitic flies also depend in considerable measure for sustenance upon white grubs. A bee fly, Sparnopolius fulvus Wied. has been reared in Illinois from white grubs, and the same is true of the peculiar Pyrgota undata Wied., a species which unfortunately seems to be not very abundant in New

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York State. A large white maggot about an inch long and possibly a species of Erax was abundant in what had been badly infested sod at East Schodack, the maggots being in the proportion of four to one of the white grubs. This insect appears to be a very efficient natural enemy. There are doubtless a number of other insects which live at the expense of white grubs and which have not been reared, owing to the fact that parasitized white grubs are very apt to be overlooked in making examinations of the soil.

The peculiar white grub fungus, Cordyceps ravenelii Berkl., was found upon the farm of Mr W. S. Miller, East Greenbush. Infected grubs are easily recognized by the slender, hornlike processes arising from beneath the head and frequently attaining a length three to four times that of the grub. These growths are at first green and later they turn brown. Mr Miller states that infected grubs were easily found over a considerable area.

Preventives and remedies. The extended life cycle of these insects and their practical restriction to grasslands make it apparent that systematic rotation of crops is one of the most important preventive measures that can be employed. It does not follow from the above that new seedings may not be occasionally attacked, as was the case last year, since numerous beetles emerging from old meadows in some instances deposited numerous eggs in recent seedings and, as a consequence, serious damage developed the following year. A rotation of crops which does not allow land to remain in sod for more than two or three years, if generally followed in a neighborhood, will result in reducing the danger of injury from these pests to a minimum. Such a method of farm management is also advisable from the general agricultural standpoint.

The danger of planting corn, potatoes or strawberries upon recently turned sod, especially if the latter is infested by white grubs, should be more generally recognized. The severe damage frequently following such practice is due to the great restriction in the number of plants per acre and the inevitable concentration of the grubs upon the small amount of food available. There is no evidence to show that the larvae or white grubs migrate to any extent through the soil. They may make their way for a distance of possibly one or two rods but hardly farther. Grassland badly infested with white grubs should, if plowed, be sowed with some such crop as rye which would grow with sufficient vigor to withstand any reasonable injury and produce a crop, or if an ordinary

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hoed crop must be planted on such land, use an extra amount of seed and feed liberally, supplementing this with good cultivation in order to enable the crop to withstand successfully the probable injury

There is no practical method of destroying white grubs in the soil, aside possibly from giving pigs the run of the field prior to planting time. Experience has shown the practicability, in the case of recently set strawberry fields, of digging out and destroying the grubs working at the base of individual plants. This latter is somewhat costly and is practical only after the injury has developed to such an extent that one can detect affected plants. It can be advised only in cases where it is impractical to avoid such conditions.

Numerous white grubs in a lawn or in a garden where values are relatively high can be destroyed by the use of a dilute kerosene emulsion, say 1 part of the standard formula to 9 parts of water. A liberal amount of the spray should be applied and then followed by a thorough soaking with a garden hose in order to wash the emulsion down, bring it into contact with the grubs and eventually carry it beyond the reach of most of the root fibers. Carbon bisulphid has also been advised for the destruction of grubs about plants. This material, if employed, should be used with care and be preceded by a few experiments to determine the possibilities under given conditions, since the danger of injuring vegetation would depend in considerable measure upon the texture of the soil and the amount of moisture present.

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HICKORY BARK BORER

Eccoptogaster quadrispinosa Say

The destructive work of the hickory bark borer in the Hudson valley, begun some three years ago, has been continued the past season. A number of dying trees were observed in the immediate vicinity of New York City, while many others have been seriously infested during the past season. A personal examination of conditions at Tivoli showed that similar conditions prevailed in that section.

Signs of infestation. The preliminary signs of injury, such as wilting leaves and dead twigs during July and early August, are exceedingly important because they indicate the presence of a destructive pest before matters have passed the remedial stage. The attack, as characterized above, simply indicates that the beetles are about to enter the tree and that if affected twigs are numerous, the pests may destroy the hickory. Examination of injured trees in the fall or during the winter may show particles of brown or white sawdust in the crevices of the bark, and in the case of some trees, a few to many circular holes appearing as though they had been made by number 8 buckshot. The recognition of this sawdust is a decided advantage, since the dark brown or black, rather stout, cylindric beetles about one-fifth of an inch long invariably start their galleries under a protecting scale of bark and the sawdust mentioned above is therefore the only external evidence of injury. Such trees are more dangerous to the welfare of adjacent living hickories than others which may be fairly peppered with numerous exit holes. The external evidence cited above should be followed up by cutting down to the sapwood. The exposure there of longitudinal galleries one to one and one-half inches long, about one-eighth of an inch in diameter and with numerous fine, transverse galleries arising therefrom and gradually spreading out somewhat fan-shaped, is conclusive evidence as to



Fig. 8 Hickory bark beetle. The smaller figure shows the gallery of the adult and the egg notches, the larger the galleries of young larvae (original)

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the identity of this pest. In very early stages of the attack the longitudinal gallery described above, with a series of minute notches for the reception of eggs on either side, may be all that can be found. Only a little experience is necessary before one can recognize the characteristic galleries of this borer. They are almost invariably to be found somewhere upon infested trees, since an attack is rarely discovered before at least some of the grubs have commenced working across the bast fibers.

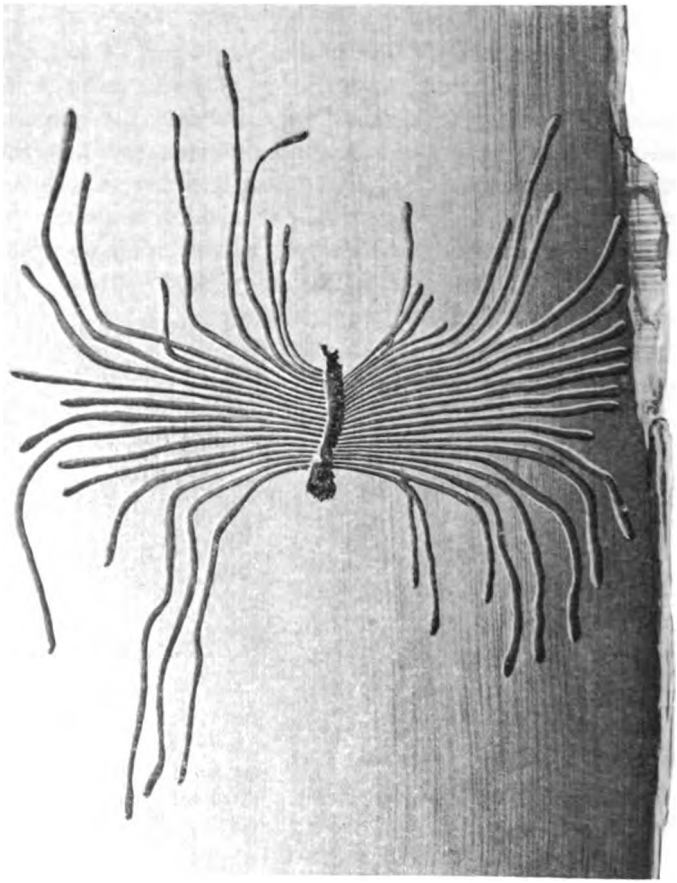


Fig 9 Hickory bark beetle, galleries made by the adult and the full-grown larvae (original)

Life history and habits. The life history of this borer may be summarized as follows: The beetles appear from the last of June till the last of July and may be found in New York State up

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to the middle of August. Observations at Bronxville on July 10th showed numerous dead leaves and tips of branches upon affected trees. The beetles were then just beginning to enter the bark. On August 5th a number of beetles were still working in the leaf stem, others were entering the bark and some had evidently become well established. The beetles bore the young twigs and burrow in the terminal buds and green nuts, evidently for food, and in this manner frequently cause the wilting of leaves and the death of twigs. Later they attack the bark of the trunk and the larger branches, each female making a vertical gallery an inch or more in length, along the sides of which she deposits in small notches, 20 to 40 or 50 eggs. These galleries of the adults are usually very regularly placed, their position apparently being determined in large measure by the long cracks in the rougher bark of the trees. The eggs soon hatch and the grubs work in the tissues, at first at nearly right angles to the primary galleries and later the borers turn in either direction till they run nearly parallel with the wood and produce a rather characteristic fan-shaped series of galleries. The burrows of the grubs or larvae rarely cross each other. On October 1st most of the larval galleries observed were from one-half to three-quarters of an inch long and the grubs about one quarter grown. They winter in a partly grown condition, transform to pupae the last of May and the beetles begin to appear about a month later. There is no evidence to show that more than one generation occurs in New York State, at least.

Experimental work. The following field work was conducted at Bronxville in cooperation with Mr J. James de Vyver of Mount Vernon.

Barcurol. A 10 per cent solution of this proprietary material was applied July 12th to certain hickory trees which were examined August 5th. It was then evident that this compound had a distinct hardening effect upon the outer bark of the tree though there was no penetration by the beetles, a fact confirmed by subsequent observations October 1st. An examination of a few burrows made by the beetles prior to the application showed that the discoloration of the inner bark was confined to the immediate vicinity of the galleries and occurred to an almost equal extent on untreated trees. The brown tissues in the latter instance extended to within about an inch of where living grubs were working. Another tree treated with a 50 per cent solution of this material was examined August 5th and it was seen that the application had destroyed the borers.

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Kerosene emulsion. One tree was painted with an undiluted stock kerosene emulsion July 25th. An examination on October 5th showed very little penetration of the bark in the vicinity of the galleries and no living insects were to be found in the burrows started prior to the treatment. Some beetles were entering the bark at the time of our examination and were evidently not deterred therefrom by the earlier application.

A 50 per cent kerosene emulsion was sprayed upon another tree the same date, and observation on August 5th showed that the insects were destroyed in the burrows and that there was also some penetration of the adjacent tissues. The outer bark did not seem to be affected in the least.

Scalecide. A 20 per cent solution of this proprietary compound was applied to infested trees September 7th and an examination on October 1st showed living grubs in four out of five burrows. In one case the larvae had made their way to a distance of two inches from the gallery made by the female. This had a thicker bark than the one treated with Barcurol or carbolic acid and the comparison was therefore not exactly fair. It is likewise probable that the treatment was made too late in the season to give the best results, since the grubs were evidently some distance from the female gallery and therefore mostly out of reach of the application.

Carbolic acid. This was prepared by diluting a gallon of soft soap with an equal amount of hot water and stirring therein a pint of crude carbolic acid (½ pint refined), allowing it to set over night and then adding 8 gallons of soft water. This solution was applied to trees on September 7th, and examination on October 1st showed discolored areas on each side of the main gallery for a distance of about three-quarters to one and one-quarter inches. There were very few or no grubs found alive and the adjacent tissues were healthy and apparently uninjured. This treatment was made to a thinner barked tree than the one treated with scalecide and the grubs were therefore somewhat more accessible.

Black leaf 40. A few trees were treated with this material used at the rate of 1 to 200 and adding thereto 3 pounds of soap to each 50 gallons of water. The trees were sprayed September 7th. An examination on October 1st showed the presence of some living larvae under the rather thick bark. This treatment, as in the case of others given at this date, was too late for us to expect the best results, and in this particular instance was limited to trees with a thick bark, the latter rendering the penetration by the insecticide more difficult.

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The above experiments, while by no means conclusive, give sufficient data to warrant a continuance of the work, particularly with a preparation of oil or carbolic acid for the purpose of destroying the beetles or the recently hatched grubs before they have had an opportunity to bore any distance from the egg chambers. This treatment, it should be stated, can be recommended only for specially valued trees on lawns or in parks. It is possible that a spray with a whale oil soap solution, a lime-sulphur wash or even a thick whitewash just before the beetles begin to enter the bark of the trunk would prove of considerable service in preventing attack and be nearly as effective as the treatments tested above. This problem can be settled only by further experimental work.

Mr Henry Bird, of Rye, informs us that in his opinion the treatment of infested trees after oviposition seems feasible in certain cases. He found that spraying with a strong whale oil soap solution just before the females began to enter the trees, seemed to drive away the insects and prevent infestation. This, he states, proved to be the case with one large tree which during the month of July, was infested by hundreds of beetles feeding upon the leaf petioles. He found spraying with arsenate of lead of no service and a similar report was received from Mr de Vyver, though the treatment by the latter was, in our opinion, too late to be of material service. Mr Bird found from experience that treatment of individual galleries was less laborious than he had supposed. He personally went over several trees between the 20th and 23d of August in an area where the insects were abundant, the trees being 40 feet high and having between 200 and 300 galleries in the bark. He used a small squirt can oiler and about a quart of gasolene to the tree, only enough being injected to destroy the females or the eggs. This treatment he found caused no appreciable injury to adjacent tissues. His work with this oil was limited to moderate sized trees a foot or more in diameter and some thirty-five years old. It would undoubtedly be more difficult to treat larger trees in this manner, though in the case of highly valued hickories one could hardly class this method as impractical.

Preventive measures. It is well known that plants are more susceptible to the attack of various insects when in an unthrifty condition. It is probable that the excessive droughts and extremely low winter temperatures of recent years have had an

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important effect upon many trees, lowering their vitality and presumably making conditions more favorable for insect attack. This unfortunate condition may be accentuated in certain localities as, for example, in southeastern Westchester county, by the abundance of canker worms or other leaf feeders, since repeated destruction of the foliage would weaken the trees and, in the case of developing leaves, might cause serious injury without attracting much attention. Mr Henry Bird believes that he has detected a connection between successive attacks by canker worms and injury by the hickory bark beetle.

Another factor which may be more important than many realize, is forest fires or burnings. It is unfortunately the practice in some communities to burn over pasture and woodlands rather freely in the mistaken notion that benefit accrues. It is true that such procedure is followed by a more vigorous growth of grass and is generally accompanied by the destruction of leaf mold or humus, not to mention the killing of numerous small trees and injuring some of the larger ones. Moreover, this humus is a most important ingredient in maintaining the fertility of the soil and also of much service in protecting the roots of trees from excessively low temperatures, and by conserving moisture mitigates in considerable measure, the severity of droughts. The greater exposure to extreme temperatures and the additional severity of droughts following the annual practice of burning, may well result in reducing the vitality of the trees and bringing about a condition favorable to attack by borers. Such procedure is at least indefensible from the standpoint of the forester and should be condemned and avoided wherever possible.

Generally speaking, we may expect the least trouble from injurious insects where normal forest conditions prevail and the trees as a whole are in a thriving condition. All practical measures which result in the removal of sickly and dying trees and provide better conditions for those allowed to remain will, in a general way, reduce the liability of serious injury by insects.

Remedial measures. A serious infestation, indicated by dying trees or branches, can be controlled only by cutting out all badly infested trees or portions of the same and destroying the bark before the following June in order to prevent the grubs then in the trees from maturing and changing to beetles which might another season continue the work in previously uninfested trees. It is particularly important to locate hickories which have died

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wholly or in part the past summer, because it is these trees which contain living grubs. General cooperation over an extended area, in the cutting out of infested trees and burning of the bark as outlined above, will do much to check this deadly enemy of hickories. It is a method which has been tried in some sections with marked success and is more practical on large holdings than where the cooperation of numerous owners must be secured. This destruction of the insects does not prevent the utilization of the wood and timber commercially, provided the bark is destroyed within the above given time limits. Slabs from sawlogs and firewood with the bark on should all be burned during the winter. If it is impractical to work up the logs and burn the slabwood, the borers can be destroyed by a prolonged submergence in water or by removing only the bark and burning that.

The possibility of protecting trees which have been entered the past season, is discussed under experimental work. Such treatment can never be advised for ordinary woodland conditions.

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PEAR THRIPS

Euthrips pyri Daniel

The pear thrips is a slender, dark brown insect only about one-twentieth of an inch long and with very delicate, narrow, long-fringed wings (Plate 3). It appears with the opening of the leaf buds and when numerous may literally blast the developing blossoms and destroy the crop. This new pest was discovered in California in 1904, has been under investigation in that region for the past eight years, and was found in the Hudson valley by Professor Parrott in 1911. Evidence at hand renders it very probable that this insect has been in New York State for some time and that the mysterious failures of the pear crop in recent years attributed to "blossom blight" or some obscure cause may have been due to the work of this minute enemy.

Widely distributed in the Hudson valley. Early in May we found the pear thrips in an apple orchard near Ravena and very abundant in a pear orchard at Coeymans Hollow. Specimens were also received from Grapeville several miles distant. The insect is generally distributed about Germantown and was very abundant in the orchard of Spencer Brothers at Hudson. It has also been found back of Poughkeepsie and at Milton, Marlborough and Newburgh.

Injuries. Personal examinations at Geneva and Hudson in company with Professor Parrott, showed a nearly total destruction of the fruit buds in a number of orchards. The young leaves had assumed a characteristic spoon shape, the tips were browned or black, while the blossom buds were partially wilted masses of browning tissue. Some 200 seckel pear trees in the orchard of Spencer Brothers were full of just such fruit buds, the loss amounting to about 400 barrels of fruit.

A local pest. Though widely distributed in the Hudson valley, this insect is a local pest which may be very injurious in one orchard or even a portion of an orchard and hardly noticeable elsewhere. The restricted character of the outbreak was very well shown in the orchard of Spencer Brothers. Here a large block of vigorous seckel pear trees, some 200 in number, had practically all the bloom destroyed, while Kieffers, lying west of the seckels and also down on the hillside, were comparatively unaffected. Those east of the seckel block and farther up the hill had most of the blossoms in the upper part of the tree destroyed. It would seem from this as though

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these insects drift with the wind and were probably carried from the seckels to the Kieffers by light breezes which would naturally sweep up the hill.

A marked restriction, though not on such an extended scale, was likewise observed in an orchard at Coeymans Hollow and also in that of Mr William Albright about two and one-half miles from New Baltimore Station. In the latter instance injury was particularly marked in a hollow and extending part way up on a knoll, while those on the knoll and beyond were not seriously affected though the pest was to be found even there in small numbers.

Description. The fruit growers will recognize this insect most easily by its operations as characterized above, nevertheless, for an accurate determination, especially in the case of outbreaks at a distance from known infested areas, the microscopic characteristics of the adult must be recognized and on this account we reproduce below the excellent original description:

Female. Length, 1.26 mm; width of mesothorax, .32 mm; general color, dark brown. Head about as long as broad; cheeks convexed; anterior margin broad, acutely angular; back of head transversely wrinkled, and bearing a few minute spines. Eyes medium, black, with light borders rounded or oval in outline, coarsely faceted, hairy. Ocelli yellow, margined inwardly with reddish brown crescents, widely separated, posterior ones contiguous, with light borders around eyes; one very long slender spine on each side midway between ocelli. Mouth cone pointed, tipped with black; maxillary palpi three-segmented. Antennae eight-segmented, approximate, slightly over twice the length of head. Length of segments: 33, 43, 55, 52, 35, 50, 8, 10. Antennae brown, except segment 3, which is yellow. Spines pale, conspicuous, special sense organs on segments 3 and 4.

Prothorax longer and wider than head; bears many prominent spines, the one at each anterior angle, and the two at each posterior angle are longest. Color, yellow-brown; faintly cross-striated.

Mesothorax approximately as wide as antennae are long; front angles obtusely rounded; metanotal plate bears four spines close to front edge, middle pair equal in size and prominence to those at the angles of prothorax, the others are small; pterothorax yellow-brown, transversely wrinkled.

Wings present, extending slightly beyond abdomen, about twelve times as long as wide, pointed at ends; surface of wings thickly covered with minute brown spines; both longitudinal veins and costa of forewings thickly set with quite long, brown-colored spines, placed regularly on costa and hind vein; costa has from 29 to 33 spines, forevein 12 to 15, and hind vein 15 to 16; veins not prominent; costal fringe of forewings about twice as long as costal spines.

Legs moderately long, scarcely thickened; femora and all except

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the terminal part of tibia brown; terminal part and tibia and tarsi yellow, a double row of twelve strong spines on the inner side of hind tibia, several inconspicuous spines on fore and middle pairs.

Abdomen about two and one-half times as long as width of mesothorax, cylindrical to eighth segment, then abruptly pointed. Spines on sides and around tip of abdomen dark brown, conspicuous; those on last two segments are long and approximately equal. Color of abdomen dark brown, connective tissue yellow.

The young closely resemble the adult structurally, though there is a variation in size, and this stage is also characterized by the absence of wings.

Life history. Investigations on both sides of the continent show that this pest winters in the soil, appearing upon the trees as the young leaves push from the buds, and feeds by preference upon the more tender and essential parts of the fruit buds. The slender, dark brown thrips may be found crawling between the partly opened leaves and working their way to the base of clusters of fruit buds. This habit of sheltering themselves among the growing tissues materially lessens the efficacy of spray applications. Buds thickly infested with thrips become sticky, the blossom buds assume a brown, blasted appearance, the bud scales drop in unusual numbers, while affected blossom clusters gradually shrivel and fall. The stems of the young fruits are also injured, frequently resulting in an early dropping. The affected leaves are small, more or less crinkled, and with a characteristic spoon-shaped development. This condition may be true of extended areas, limited to a few trees here and there in an orchard, or confined to portions of trees and, in the latter instance, result in a very uneven setting of fruit (see plates 1, 2).

The microscopic eggs are deposited in minute slits in leaf and blossom stems. The whitish, red-eyed young soon appear and feed like the darker parents, on the tender leaves for about two weeks, drop to the ground and remain in the soil unchanged till fall. The insects produce small wounds on the foliage, the affected tissues drop out or break and seriously injured leaves are, as a consequence, badly perforated and quite ragged in appearance.

Food plants. This minute enemy attacks a variety of deciduous fruits, having been recorded from apple, apricot, cherry, fig, grape, peach, pear, plum, prune, quince and the English walnut. The principal damage, as indicated by the common name, is to the pear.

Distribution. This insect was first discovered in California, has been recorded from a number of localities in the Hudson valley and at Geneva, and also reported from England. Its minute size and

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the probability of its being carried in soil with young trees, greatly favors the dissemination of the pest and will undoubtedly result shortly in its general distribution, even if it has not already become established in most of the more important fruit-growing regions.

Preventive measures. An examination of conditions in the orchard of Mr William Albright near New Baltimore resulted in our learning that several years before, this pear orchard had been affected in a similar manner, and that the injury at that time, as well as that of last spring, occurred during seasons when the orchard had not been cultivated early in the spring. An examination of infested orchards at Coeymans Hollow, at Germantown and at Hudson showed that without exception the injury occurred on a heavy soil where early and thorough cultivation was presumably difficult or impossible. The pear thrips appears to be absent from orchards on the lighter, sandy soil of Kinderhook. It may be only a coincidence, yet the fact that this delicate insect winters in the soil and has been in at least one instance seriously injurious to orchards which were not cultivated till late, suggests that in early cultivation, where practical, we may find a feasible method of preventing injury and avoid the relative costly repeated sprayings necessary where the insect is numerous.

Remedial measures. The appearance of hosts of thrips in the early spring and their rapid work upon the developing leaves and fruit makes promptness an essential in the control of the pest. Experience has shown that the thrips, when abundant, may practically destroy a crop in a few days and, furthermore, that most of those which can be reached by a spray succumb readily to the use of a tobacco extract such as black leaf 40 employed at the rate of ½ pint to 100 gallons of water to which was added 2 pounds of soap. Mr William Albright sprayed with this solution about 11.30 in the morning, shortly before it began to rain. It rained until about 2 p. m., and an examination thereafter showed numerous dead or dying thrips. The best results will be secured when this insecticide is applied as a coarse forcible spray, the nozzles being adjusted so as to throw the material down into the clusters of leaves and blossom buds. In the case of bad infestations, namely, where 10 to 15 thrips may be found in a single blossom cluster, a second spraying may be necessary the following day and a third possibly after the petals drop, for the purpose of destroying the young before they desert the trees and enter the soil.

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The most effective spraying is while the buds are swollen and before they have opened sufficiently to produce crevices in which the thrips may find shelter and after the blossom clusters have separated so as to expose the thrips sheltering among the stems of the young fruit.

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QUEEN BLOW FLY

Phormia regina Meign.

A study of the queen blow fly was undertaken for the purpose of obtaining data which could be used as a basis for estimating the period a human body had lain exposed to the elements in midsummer. We found so little definite in available literature concerning the biology of the blow fly, and especially the duration of the various stages, that it was necessary to work out the life history before attempting a moderately accurate estimate of the age of certain maggots taken from the corpse. It was supposed at the inception of the work that the so-called common blow fly, Calliphora erythrocephala Meign. was the more prevalent species at Nassau, the place where these investigations were conducted. Our experiments resulted in rearing only the above named species, kindly determined by Mr C. W. Johnson of the Boston Society of Natural History, and a flesh fly, which latter will be discussed subsequently. There seems to be comparatively little known concerning this blow fly. Mr G. N. Hough records this species as very common everywhere in this country, though it appears to be rare in Europe. Aldrich lists it from such widely separated localities as New Jersey, Montreal and New Mexico. It is worthy of note in this connection that Mr J. H. Paine reared this species in larger numbers from city garbage in Boston, Mass., than either the common house fly or the bluebottle fly, Lucilia sericata, though it should be noted that Phormia was present in fewer lots and that by far the most came from one lot, concerning which there seems to be no special record except that no house flies were obtained and the material was collected in August.

Methods. The head of a recently killed calf was procured about 6 p. m. August 1st, and on account of the low temperature prevailing for that season, no ova were deposited upon the head that evening. It was exposed throughout the next day which was moderately cool, in a place protected from larger animals, and at 5 p. m. there were hundreds of eggs about the mouth and in the hair at the base of the horns. Several flies were observed in the immediate vicinity. This was the source of the material upon which the following notes are based, since flying insects were excluded after this primary infestation. Observations were made and material collected about 7 a. m. and 6 p. m. during most of the

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period. The temperature conditions prevailing at the time the following observations were made are tabulated below, together with a transcript for the corresponding period of the official weather bureau records at Albany for the purpose of comparison.

Temperature records

DATE		ALBANY		NASSAU [1]	
Month	Day	Max.	Min.	Max.	Min.
August	1	74	57	....	64
	2	76	52	....	....
	3	71	58	....	....
	4	72	56	65	56
	5	76	52	69	50
	6	78	52	72	62
	7	77	54	70	58
	8	79	61	68	58
	9	79	67	69	66
	10	79	69	71	67
	11	85	68	81	78
	12	84	69	90	72
	13	87	68	86	71
	14	86	70	91	69
	15	82	62	89	72
	16	71	55	83	64
	17	72	48	77	51
	18	65	59	79	62
	19	76	60	63	63
	20	81	65	80	67
	21	73	58	83	60
	22	83	62	....	....
	23	73	60	....	....
	24	77	59	....	a68
	25	88	68	b76	....
	26	84	67	88	66
	27	77	57	86	67
	28	72	51	87	48
	29	74	54	87	58
	30	68	47	75	45
	31	64	43	75	45
September	1	64	54	68	45
	2	65	58	63	59
	3	68	59	67	58
	4	78	64	68	59
	5	78	64	81	61
	6	80	67	80	64
	7	82	64	80	62
	8	82	60	85	62
	9	80	60	82	59
	10	80	54	83	53
	11	83	58	82	54
	12	70	50	83	52
	13	75	54	83	52
	14	72	63	79	53
	15	81	68	71	63
	16	73	52	83	62
	17	70	57	72	46

[1] Records from August 1st to 11th inclusive are based on morning and evening readings and therefore do not represent the true maximum and minimum, though approximating thereto.
a This is a minimum record for the preceding two days during which readings were not taken.
b This is a maximum record for the preceding three days during which readings were not taken.

Biology. Hundreds of eggs were noted at 5 p. m. August 2d and the next morning. Though the night was cool, hatching was in progress and at 6 p. m. the same day most of the eggs had hatched and the young maggots, about 2 mm long, were collected

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in a slight depression on the cut surface of the head. These conditions persisted unchanged except that the maggots became possibly a little more active with the progress of time till the morning of August 6th when there were many second stage maggots about 3.5 mm long and some first stage maggots about 3 mm long. The difference in size between these two stages was so slight that the change from one to the other occurred without attracting particular notice. The night of the following day, August 7th, the second stage maggots were some 6 mm long and perceptibly larger. There was also observed one larger third stage maggot having a length of about 13 mm. The following morning, August 8th, four or five large third stage maggots were observed, and by night one-third of them had similarly changed. The following morning, August 9th, most of the maggots visible, namely, some seven-eighths, were in the third stage and moving actively over the cut surface of the head. The maggots at this time were distinctly negatively heliotropic and when kept in darkness showed little tendency to burrow into the tissues. They collected in a hemispheric mass an inch or more in depth on the upper cut surface and remained so long as it was kept dark, scattering only with the admission of light. This negative heliotropism was mare marked as the larvae developed and by the time they attained full size there was a speedy scattering on admission of light, even though the mass of maggots when exposed to illumination had a depth of an inch or more and covered the ten or twelve square inches of surface. The following day, August 10th, no small maggots were observed and all were evidently nearly full grown and ready to desert the carrion, such migration occurring the following morning. The maggots remained for several days in the upper layers of adjacent moist soil, being so numerous for a time as to transform this part into a heaving, animated mass. The larvae began to become sluggish prior to pupation on the morning of August 13th, and that night puparia were numerous though there were still many full-grown larvae. Phormia larvae persisted in decreasing numbers till August 16th, and on the 25th numerous adults were obtained. The insects continued to emerge in large numbers for several days.

The duration of the various stages is approximately as follows: eggs, 12 to 24 hours, much depending upon temperature conditions.

The first larval stage lasted about three days, probably being somewhat prolonged by the rather low temperatures prevailing. The second stage persisted two to three days, while the period of

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active feeding in the third stage was limited to about three days, though the transformation to puparia did not occur till three days later.

Description. *Egg.* Length 1.5 mm, elongate, elliptic, tapering slightly toward one extremity. The eggs are deposited in agglutinated masses of varying number.

Larva, general characters. White, narrowly conical, the posterior extremity subtruncate, length 2 to 13 mm.

First stage. Length 2 to 3 mm, diameter .3 mm, tapering slightly to the anterior segments, which latter taper sharply, the segmentation distinct and marked with a series of transverse bands of short, dark, chitinous points on each body segment. The cephalo-pharyngeal skeleton is very characteristic in this stage The mandibular sclerites are slender, nearly rectilinear, and at the anterior extremity there may be found a pair of stomal plates, each with six minute teeth; dental sclerite rudimentary; hypostomal sclerite slender, slightly curved; lateral pharyngeal sclerite with a long, rectilinear anterior process, the main part being a broad dorso-ventral bar of chitin produced posteriorly at both the dorsal and ventral angles as a tapering and relatively narrow process. The dorsal sclerite is slender, strongly looped and unites the two lateral pharyngeal plates (plate 4, figure 1); posterior spiracles (plate 5, figure 1) with one well-developed, narrowly oval orifice and apparently a rudimentary second.

Second stage. Length 3.5 to 6 mm, diameter about 1 mm. General characters as in the preceding stage. Cephalo-pharyngeal skeleton: mandibular sclerites moderately heavy, somewhat decurved and irregular; dental sclerite moderately heavy, short, broadly triangular; hypostomal sclerite shortened, heavy, irregular and united with its fellow by a moderately broad dorsal process; lateral pharyngeal sclerite consisting of a broad dorso-ventral plate with a curved, tapering process on the anterior ventral angle; a short, broad, truncate process posteriorly on the dorsal angle and a longer, tapering process posteriorly on the ventral angle, the dorsal sclerite rather broad and strongly arched (plate 4, figure 2); structure of anterior spiracle indistinct; posterior spiracles (plate 5, figure 2), each with two slightly curved, well-chitinized orifices.

Third stage. Length 13 to 17 mm, diameter about 3 mm. General structure about as in the preceding stages. Cephalo-pharyngeal skeleton: mandibular sclerites stout, heavily chitinized, strongly decurved; dental sclerite small, broadly triangular; hypostomal sclerite short, irregular; lateral pharyngeal sclerite broad, with a long,

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slender, slightly curved process at the anterior ventral angle, a broad subtruncate process posteriorly along the ventral line and a longer, broad process from the posterior-dorsal portion, the distal part of the latter tapering suddenly to a subacute apex; dorsal sclerite short, slender (plate 4, figure 3); anterior spiracle distinct, broad, with ten or eleven radially arranged orifices; posterior spiracles, each with three rather broad, heavily chitinized, subparallel orifices (plate 6, figure 2). The subtruncate posterior portion has a well-developed truncate lobe on the ventral surface and a distinct, cup-shaped dorsal cavity guarding the spiracles and margined with irregular and rather minute, fleshy lobes.

Puparium. Length 9 to 9.5 mm, diameter 3 to 4 mm. Color light brown, turning to a dark brown, almost black. The anterior extremity is narrowly rounded and somewhat constricted subapically, each segment with a double transverse band of chitinous points; posterior extremity contracted subapically and easily recognized by the submedian spiracles located in a somewhat illy defined depression margined with irregular, short, broad, chitinous tubercles.

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GEORGIAN FLESH FLY

Sarcophaga georgina Wied.

A number of this large, grayish, yellowish or red-tailed flesh fly were reared in association with Phormia regina Meign. and provisionally identified by Mr C. W. Johnson of the Boston Society of Natural History.

One of the earliest notices of this form is by Harris, who characterizes the species as one of our largest viviparous flesh flies which appears toward the end of June and continues till the middle of August or perhaps later. It has been recorded by the late Doctor Smith as common throughout the state of New Jersey and is listed by Aldrich from Georgia, Massachusetts and British America. It has been reported as parasitic by Prof. C. M. Webster on grasshoppers in Wyoming. The record states that the maggots of this species were abundant in a mass of "dead disintegrating and decaying bodies" of Melanoplus differentialis Thos.

The discussion of methods and conditions under Phormia apply equally well to this species, except that the presence of the larvae were not observed till considerably later and manifestly when conditions were quite different.

Biology. On August 12th, a time when the disintegration of the carrion was in an advanced condition, a very few small, and at that time supposed to be first stage maggots, were observed on the calf's head in association with full-grown Phormia larvae. The following day it was noticed that there was a fairly good colony of Sarcophagid larvae clustering as before and evidently the product of a recent and presumably accidental ovi or larviposition. The next day, August 14th, most of these young larvae were small though a few appeared to be in the second stage, a transformation which was more marked August 15th. On the afternoon of the 16th there were many small, probably second stage maggots and one very large, probably third stage maggot, the latter being more abundant the following morning and on the 18th. August 19th at 6 p. m. nearly one hundred of these large larvae had escaped from the bucket containing the carrion and had established themselves just below the surface of the loose soil near a door sill where there was moderate protection from light. These larvae displayed a much greater activity in wandering than was the case with the

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earlier reared Phormia larvae. The maggots were placed in a fruit jar containing earth and remained moderately active and in the larval condition till the 25th, at which time a few recent puparia were found. Most of the maggots were then at the bottom of the soil in the jar and not on the surface, as was the case with many of the Phormia larvae. The Sarcophagid larvae transformed slowly to puparia and no flies were reared till September 15th, others appearing on the 16th and 17th.

Summarizing, an examination of material shows that the first stage had nearly passed before the maggots were observed. The second larval stage lasted about four days and the third three days, the prepupal condition persisting for about six days and the insects remaining in puparia 22 to 23 days.

Description. *First stage.* Length 2 mm, diameter .3 mm, whitish, slender, hardly tapering anteriorly, subtruncate posteriorly, the segmentation distinct and marked with a series of transverse bands of short, dark, chitinous points. The cephalo-pharyngeal skeleton is very similar to that of Phormia, the mandibular sclerites are slender, nearly rectilinear; the stomal plates rather large, the teeth irregular; hypostomal sclerites slender, slightly curved, lateral pharyngeal sclerite transverse, broad, and with tapering dorsal and ventral processes posteriorly, the former being somewhat longer; the dorsal sclerite is slender, strongly lobed and unites the two lateral pharyngeal plates; posterior spiracles apparently with two weakly chitinized openings.

Second stage. Length 5 to 6 mm, diameter .6 to 1 mm, whitish, slender, tapering slightly to the anterior extremity. Cephalo-pharyngeal skeleton: mandibular sclerites heavy, rather strongly decurved, basal portion broadly triangular; dental sclerite short, stout, strongly curved, free; hypostomal sclerite moderately short, stout, and united with its fellow by a broad, chitinous bar; lateral pharyngeal sclerites, anterior portion broadly transverse, subrectangular and with long ventral and dorsal processes posteriorly, the latter somewhat longer and more tapering; posterior spiracles each with two, moderately chitinized, orifices. Cuticular chitinization mostly equally bidentate.

Third stage. Length about 16 mm, diameter 2½ to 3 mm, whitish, slender and tapering from the obliquely truncate posterior extremity to a slender apex. Cephalo-pharyngeal skeleton: mandibular sclerite stout, decurved, the basal portion with a triangular lobe ventrally; dental sclerite short, irregular; hypostomal

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sclerite short, irregularly triangular; lateral pharyngeal sclerite broad, the anterior portion with a length greater than its width and with broad, irregular processes posteriorly at the dorsal and ventral angles, that at the dorsal angle somewhat longer and more tapering (plate 7, figure 3); anterior spiracles yellowish brown, expanded and opening in about 18 small, radially arranged orifices (plate 7, figure 2); posterior spiracles (plate 7, figure 1) with three narrow, somewhat radially grouped orifices located in a distinct cup-shaped depression, much more marked than in Phormia and guarded by a series of fleshy tubercles and ventrally with a median lip, the latter with fleshy processes at the lateral angles.

Puparium. Length 9.5 mm, diameter 4 mm, color light brown, turning to a dark brown. The anterior extremity tapers rather sharply and is subtruncate, while the posterior extremity tapers gradually to a deep, cup-shaped depression surrounded by an irregularly tubercled wall.

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THE USE OF OILS ON DORMANT TREES

Spraying dormant trees with oils, especially mineral oils, is one of the more recent developments of insect control work. The late Dr J. B. Smith, late state entomologist of New Jersey, was one of the foremost advocates of this practice and at one time took the position that petroleum was "harmless to the most tender varieties and the youngest trees." It should be added that later this pronouncement was modified to "a reasonably safe, economic and effective material." Injury was noted following petroleum applications, and shortly the miscible oils were placed on the market and used probably much more generally than was the case with petroleum, either pure or in mechanical emulsions. The great advantage of the miscible oils is that they make possible a nearly uniform emulsion of known strength and there has been much less apparent injury following their use. The ideal in these latter is a stable emulsion which can be kept indefinitely, diluted to any desired strength and which will destroy scale and other insects without injuring the tree or plant. Some enthusiasts have almost gone so far as to assert that injury could not follow the use of even large percentages of some of the miscible oils.

Safety a prime essential. A fruiting orchard represents a considerable investment, and we believe that most fruit growers rightly consider the safety of the trees of more importance than the destruction of an insect pest or the prevention of possible injury. The remedy should not be worse than the disease and the treatment should most certainly not jeopardize the investment. We are unwilling to sanction, even by implication, the use of compounds which may result in material injury and, in some cases, disaster to the orchard.

Injury by petroleum. The writer's experience with petroleum and mechanical emulsions of petroleum in 1900 to 1903 inclusive, shows that serious injury might result in the latitude of Albany, especially if the application was made in the fall or in the spring if followed immediately by a spell of humid weather. One fall treatment resulted in such penetration and discoloration of the inner bark that grave fears were entertained for the safety of the trees. A similar condition developed in the spring when the spraying was followed by several days of foggy weather.

Others have noted deleterious effects following the application of petroleum to various trees in widely separated sections of the

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country. This is so generally recognized that an exhaustive discussion of the evidence seems entirely unnecessary. It should suffice to note in passing, that most competent observers who have studied the effects of petroleum upon trees, emphasize the variability of the results and attribute much of this to climatic conditions prevailing at the time of spraying and for some days thereafter.

Signs of injury by petroleum. Spraying dormant trees with petroleum, pure or emulsified, may retard their development in the spring. This may be comparatively slight and followed by enlarged lenticels, a discoloration, death and cracking of the outer layers of the bark and be accompanied the first season by abnormally large, dark green leaves. The last has frequently been regarded as an evidence of benefit though it apparently results from overstimulation and may be followed, if there be successive annual treatments with oil, by smaller and eventually undersized pale foliage.

Applications followed shortly by adverse climatic conditions, such as a severe winter or several humid days immediately after spraying, may cause an extremely late starting of growth with destruction of buds, limbs, or even large portions of the tree. There is then apparently more penetration by the oil which, in extreme cases, may kill the vital tissues to the sapwood or even below. The inner bark turns dark brown, may remain sappy under certain conditions for a considerable period and have a sour or acid odor. Trees thus affected may have limbs girdled near the middle with a dead inner bark and die gradually toward each extremity, or dead branches may show a similar, well-marked, girdled or dead area at the base, while badly affected limbs exhibit localized injury to the inner bark on portions most exposed to the spray or in connection with external rough places, which latter greatly facilitate the absorption of oil. Young fruit trees may have the bark badly blistered in the late spring and early summer, the underlying tissues being soft and evidently unhealthy. The death of affected trees or portions of the same may occur the following spring, drag through the summer or be deferred for a year or more. Even the buds fail to develop in some instances, while in other cases the leaves may push out and attain a length of half an inch or more before dying. In other cases the leaves may attain full size and the tree succumb slowly in midsummer, the extent and the rapidity of the withering probably being dependent

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in considerable measure upon climatic conditions. The vigor of the roots and the lower portion of the trunk, which latter frequently escapes injury probably because of the thicker bark hindering penetration of vital tissues, is shown by the numerous sprouts on the lower part of badly affected trees. This new growth may be moderate in character or extremely vigorous, much depending upon the vitality of the tree and the number of sprouts developing.

Miscible oils. An emulsion is defined as "a mixture of liquids insoluble in one another, where one is suspended in the other in the form of minute globules." There is no hint of a chemical change, the oil is simply more finely divided and, as a consequence, more evenly distributed through the preparation. It is still oil and possesses the properties of oil, as is readily seen on the disintegration of the familiar kerosene emulsion. The term "miscible oil" has been employed in economic literature to designate emulsions or preparations of oils, usually petroleum, mixing readily with water. A number of these have been placed on the market under various trade names. Experience has demonstrated the utility of a general designation for this class of products. The commercial emulsions are usually more stable, that is, they disintegrate less readily than the homemade kerosene emulsion. They contain oil in practically an unchanged condition so far as chemical and physiological properties are concerned, and may be expected to produce effects upon plants corresponding to the amount applied, other conditions being uniform.

Injury by miscible oils. Many have been repeatedly assured that miscible oils, especially certain commercial preparations, can be applied to plants without injury. One manufacturer states that it is "absolutely impossible" for his product "to injure a tree where the simplest directions are followed." Miscible oils can and have been used under conditions which would seem almost to preclude the possibility of injury. Nevertheless, we believe there is a risk in employing these materials, largely because of our ignorance of the physiological condition of the tree and the kind of weather which may follow the spraying, both of which appear to be important factors. In addition some varieties seem to be much more susceptible to injury of this character than others. Our observations upon petroleum, noted above, appear to indicate much greater danger of penetration during the winter season, a time when the pressure of sap is greatly lessened. A sudden drop in

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temperature in the spring checks the flow of sap and, following an application of oil, is very liable to result in greatly increased penetration by the insecticide, sometimes with disastrous results. It is very likely that the apparent immunity of different varieties depends in considerable measure upon seasonal variations in the pressure of the sap, due to an early or late ripening of the wood and possibly to differences in the penetrability of the bark.

Record of injury following applications of a miscible oil. The following records are not intended to be exhaustive and are made public simply to establish the fact that serious injury may follow the use of oil preparations upon dormant trees.

In June 1911 our attention was called to the serious condition of many hard maples in Mount Vernon, sprayed the preceding spring with a miscible oil. Some of the trees most infested by insects, it is stated, were sprayed March 24th and again May 20th. There were some 2136 hard and soft maples which received this application. The soft maples were practically unharmed, while many of the hard maples, in fact all marked as having been sprayed, which we examined June 20th, showed evidence of recent serious injury, many being practically dead. This was true of small trees three inches in diameter, as well as of maples some eight inches in diameter, all, with very few exceptions, appearing as though they had been in full vigor the preceding season. Trees on one side of the street or on one block were affected, while unsprayed trees of the same variety on the opposite side of the street or on adjacent blocks were in normal condition. In some instances the damage was limited to limbs most easily reached by the usual type of spraying outfit. We were unable to find sufficient evidence of injury by insect pests or damage following general adverse conditions to account for the sudden death of so many trees in a closely restricted area. Additional details of our findings at that time are given in the report for last year (27th report of the State Entomologist, New York State Museum Bulletin 155, pages 88–92).

Personal observations during July and August of last season (1912) showed that practically all the trees noted as being badly injured the preceding year, had been removed and replaced by small trees. We were informed that 449 maples had been reset. Furthermore, some of the trees less seriously injured in 1911 showed dead limbs or patches of dead bark, and the prospect is

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fair that more of such trees will die or parts of large limbs break off in a year or two. Our attention was also called to several large sugar maples now dead, which were marked as having been sprayed the preceding year and had not been removed last year because it was supposed that they had not been seriously affected by the application. An examination of a number of representative trees here and there only served to confirm our findings of the preceding season and to exonerate injurious insects from direct responsibility in the wholesale destruction of sugar maples. The local character of the injury and the difficulty of attributing the trouble to malnutrition, overcrowding or other general adverse conditions is strongly illustrated by small to moderate sized hard maples standing in front of numbers 125, 151 and 157 Cottage avenue. The lower limbs of each of these trees had evidently died the preceding year and had been removed, although the maples stood in thrifty lawns some distance from the street and where conditions were most favorable for a vigorous growth.

After we had made examinations of the Mount Vernon maples and reached certain conclusions, we learned of similar injury following the application of a miscible oil a few years earlier to sugar maples in the vicinity of Philadelphia. There were about 100 trees sprayed, sugar maples and Norway maples alternately, and at least 75 per cent of the former, we are informed, died soon after the treatment. Those conversant with the conditions in this latter case attribute the injury to the application of oil.

The sensitiveness of the sugar maple to oil and the possibility of the rapid death following treatment therewith, is evidenced by a photograph taken by the late Professor Slingerland in July 1903 and kindly placed at our disposal by his successor, Prof. G. W. Herrick. The photograph shows several dead sugar maples and the original record is as follows: "Effect of kerosene bands on maple trees. Maple trees treated with a band of kerosene in 1902 in front of fraternity house on Seneca street (W. H. Sage home). Taken in July 1903. Trees practically dead." A band saturated with kerosene is quite different from a trunk sprayed with petroleum or miscible oil. Nevertheless it is possible to conceive of conditions under which enough oil, either pure or as an emulsion, might be left upon the trunk after the evaporation of water or other emulsifying fluids and bring about a condition nearly identical with that produced by oil-saturated bands.

The unfortunate developments on sugar maples, following the

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application of a miscible oil, find their counterpart in the case of certain fruit trees. The early history of the use of miscible oils in New York State contains several instances of severe, though somewhat restricted injury following treatment. In one instance young trees were dipped when the temperature was below 40° F. The buds were killed and the stock ruined. In another case a number of trees died after a fall application followed by a heavy, wet snow which remained on the trees for a day or two and undoubtedly promoted penetration by the oil.

The most extended injury following spraying with a miscible oil came to our attention last June. An apple orchard at Athens, set twelve years ago, was sprayed Thanksgiving week or the one following in 1911 with a miscible oil used at the rate of 4 gallons to 50 gallons of water, and about 160 trees, mostly Baldwins, were dead or in a dying condition at the time of our examination (plate 3, figure 2). There was severe and general injury to a considerable proportion of the orchard thus treated. Nine-tenths of the apple trees in one representative section were dead or nearly so. One tree said to have been sprayed with the wind from the north had most of its branches on that side killed. The restriction of the injury on other badly affected trees was such as might be expected if the damage were caused by spraying. Furthermore, dying limbs were girdled by dead inner bark near the middle or at the base, the affected tissues being dark brown, sappy and with a sour or acid odor. Many of the twigs had a reddish brown bark with some discoloration of the wood. The buds on some of the limbs failed to start, while many had only sufficient vigor to develop leaves about one-quarter the normal size. Later in the summer, with the approach of drought conditions, some of the badly affected trees and most severely injured branches succumbed. About the middle of July there was an abundant development on the dead wood of a fungus identified by State Botanist Peck as Naemospora croceola Sacc., a species which subsists only on dead bark. Numerous vigorous shoots appeared on the trunk and the larger limbs of the badly affected trees in early summer, and by fall had made a fair to extremely good growth, thus eliminating the probability of root injury. Trees most severely affected were practically free from San José scale or other insect pests which might have been a possible cause of the trouble. A number of smaller trees just to the west of one part of the badly affected area were sprayed at the same time, the insecticide being used at the rate of 3 gallons to 50

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gallons of water and here there was little or no injury. Numerous other trees in the same general region and growing under practically identical conditions, excepting that they were not sprayed with the above mentioned insecticide, were in a vigorous condition (see plates 8 and 9).

Many trees on an adjacent farm were also sprayed with the same insecticide and at about the same time, it being used in this instance, however, at the rate of 3 gallons to 50 gallons of water. A few of these trees were seriously injured. One large spy tree escaped with injury to the outer branches, those in the center being so well protected that they probably received little of the application. A large Gravenstein was badly affected on one side and it was stated that this tree was sprayed with a south wind and the injury was practically confined to the south side of the tree.

Another person in the immediate vicinity used the same material at the rate of 3 to 50, spraying at about the same time and treating many pear trees and a number of apple trees. Many of the Baldwins, in particular, died and a number of the pear trees showed unmistakable evidence of severe injury. Our attention was called to several young pear trees having extended blistered areas, and examinations later in the season showed that in some cases this was followed by death of the affected bark, and in one instance at least, by the death of the tree.

An orchard badly infested by San José scale was also sprayed in this neighborhood and there was much less injury to the trees and marked benefits so far as destroying the scale is concerned.

More disastrous conditions were noted in a Baldwin orchard some two miles distant and set nineteen years before. This orchard was sprayed with the same miscible oil, used at the rate of one gallon to 15 gallons of water, the application being made early in December, probably the 10th to the 13th inclusive. Practically all the trees sprayed at this time, over one hundred, were in a nearly ruined condition and most of them were subsequently cut down by the owner. The line of injury was very sharply defined. Trees in wet places which could not be reached on account of the soft condition of the land, and others which were not sprayed because the engine broke down, escaped without injury. Even here there were one or two trees sprayed from but one side and showing injury only on the treated portion. An examination of the dying limbs and trunks of the affected trees showed a discoloration of the inner bark and irregular spotting of vital tissues practically as noted above (see plate 8, figure 1).

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We deem it advisable, in this connection, to reproduce the records of the local weather bureau, kindly placed at our disposal by the authorities.

Climatological data at Athens 1911

MONTH	DAY	TEMPERATURES		PRECPT.	CHARACTER OF DAY
		Max.	Min.		
November	26	40	28	.04	Cloudy
	27	47	28	....	Clear
	28	56	36	T	Cloudy
	29	53	33	....	Cloudy
	30	38	23	....	Clear
December	1	44	29	....	Clear
	2	40	30	T	Cloudy
	3	40	26	....	Cloudy
	4	34	18	T	Clear
	5	28	12	....	Cloudy
	6	43	21	....	Clear
	7	44	21	....	Clear
	8	41	25	....	Partly cloudy
	9	45	28	T	Cloudy
	10	51	34	....	Cloudy
	11	60	44	....	Partly cloudy
	12	60	50	....	Cloudy
	13	59	40	....	Partly cloudy
	14	40	27	....	Cloudy
	15	39	33	.38	Cloudy
	16	40	35	.30	Cloudy
	17	43	38	.10	Clear
	18	40	30	....	Partly cloudy
	19	31	26	....	Clear
	20	32	17	....	Clear

Subsequently we learned of injuries very similar to the above in Dutchess county. The application of a miscible oil was made the last week in November and some twenty greening and northern spy trees, set ten or twelve years before, were dead by midsummer, and as many more showed evidence of more or less injury. The damage was confined, we are informed, to trees sprayed one afternoon when the sky was overcast. An examination of samples received from the affected trees showed conditions practically the same as those described above for the Athens orchards. The bark was variably cracked on a limb from a tree in a dying condition and showed here and there well-marked dead areas with greener tissues on either side. There was the familiar enlargement of the lenticels and an unhealthy, brownish condition of the inner bark. The samples were just being entered by the fruit tree bark beetle, Eccoptogaster rugulosa Ratz.

The above applications to fruit trees in Greene county were made with modern apparatus and, so far as we were able to ascer-

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tain, for the sole purpose of controlling San José scale in a satisfactory manner. We are assured by the various parties that the manufacturer's directions were carefully followed. A fruiting apple tree may be conservatively valued at $25 and upward, so that the death of one hundred trees means a loss which can hardly be estimated at less than $2500, a sum most fruit growers would miss. The possibility, we do not say probability, of such extended injury should make the fruit grower careful as to what spray material he applied.

Contributory causes. Several adverse factors have been mentioned in the above discussion, and it is only fair to attempt correctly to estimate their value, even though these inimical conditions are unavoidable in most cases. A blanket of wet snow or several days of foggy weather following spraying hinder evaporation and favor injury on account of the increased penetration likely to result. A long winter with vital activities at a minimum is undoubtedly favorable to penetration, and the same is true of a cold spell in the spring, checking growth and prolonging the period of least resistance on the part of the tree. Some trees have a thicker outer bark than others, and this dead tissue is of much value in preventing oil entering the vital tissues beneath. Variability in the thickness of this outer bark occurs not only in trees of different species but even those of the same kind. Observations go far to show that other things being equal, the thin-barked trees or branches succumb first.

It may be that excessively low winter temperatures favor penetration by oils and thus increase injury. We know that under certain conditions the vitality of trees may be destroyed by extreme cold. This is well known as winter injury and is occasionally a serious factor. It is conceivable that less severe weather might reduce the vigor of a tree to such an extent that penetration by oil and consequent injury would be greatly facilitated. Extreme winter weather is to be expected and unless there is noticeable winter injury to the same variety of trees in the section, we believe low temperatures can not be held responsible to any material extent for dying or dead trees presenting practically identical conditions and which, without exception, had been previously sprayed with an oil preparation or other insecticide known to be dangerous under certain conditions to plant life.

The fact that serious injury followed the application of oil to sugar maple trees, while spraying at the same time caused little or

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no injury to soft maples, suggests that the time of application may be extremely important in the case of some trees. The soft maple begins growth in the spring earlier than the sugar maple, and it is very possible that the marked variation in results was due largely to the difference of vital activities then obtaining.

Conclusions. The use of oils or oil preparations on dormant trees has been followed in several cases by severe injury.

Trees, as living organisms, respond to climatic and cultural conditions and as a consequence their power of resisting penetration and injury by oils undoubtedly varies with the season and probably from year to year.

Since certain weather conditions promote injury by oils, it appears impossible to be sure that deleterious effects may not follow spraying dormant trees with an oil or oil preparation.

Fall treatment with an oil appears to be more hazardous than spring applications.

Other things being equal, we believe there is less danger of penetration by oil and consequent injury if the applications are made in the spring shortly before active growth begins and presumably offers greater obstacles to entrance by oil or quickly replaces destroyed and necessary vital tissues.

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NOTES FOR THE YEAR

An interesting case of myiasis interna was reported from Kingston. The infestation presumably arose from canned sardines which had probably been left exposed for a time, since four out of six boxes examined contained eggs or larvae within the body cavities of the fish. This is more probable than to assume that the infestation occurred prior to the sealing of the cans. From the material sent us the common house fly, Musca domestica Linn., was reared.

The following brief accounts relate to some of the more injurious or interesting species coming to our attention during the year.

FRUIT TREE INSECTS

Fruit tree bark beetle (Eccoptogaster rugulosa Ratz.). This common pest, a small, brownish black beetle, about one-sixteenth of an inch long, displays a marked preference for sickly or dying limbs of peach, plum, pear and apple in about the order named. The feeding holes made by the beetles in peach bark frequently bleed freely and as a result there may be numerous masses of gummy matter adhering to a rather large portion of the trunk or limb. The beetle makes a gallery about an inch long, deposits eggs on either side and the grubs hatching therefrom make irregular, obliquely transverse galleries for a distance of about half an inch or more, the full-grown grub changing to a pupa at the extremity of the boring and emerging through a circular orifice. The pests are frequently so abundant as fairly to destroy the inner bark and outer sapwood, and on deserting the tree the numerous circular exit holes give the bark an appearance of having been riddled with fine shot. It is on this account frequently termed the shot-hole borer. There are at least two generations annually.



Fig. 10 Work of fruit tree bark beetle, the upper part showing one gallery (original, enlarged)

This pest is best controlled by promptly cutting and burning all sickly or infested limbs. It is very bad orchard practice to allow trimmings to lie around, since brush

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piles may easily produce thousands of the beetles and, when abundant, the pests may attack comparatively vigorous trees.

Apple tent caterpillar (Malacosoma americana Fabr.). Numerous complaints were received of the excessive abundance of this common pest upon wild and chokecherry trees in particular, though its conspicuous nests were rather abundant in apple trees here and there. This condition was reported from Long Island localities and various places in the Hudson valley, from Utica, Herkimer and Rome in the central part of the State, and from such Adirondack localities as Glens Falls, Lake George, Ausable Forks, Malone, and Ogdensburg. The pests were so numerous in southern Rensselaer county as to defoliate most of the roadside wild cherry trees and many of the unsprayed apple trees, not excepting in some instances almost entire orchards. The caterpillars were so abundant that they would frequently strip adjacent vegetation before attaining maturity. In some instances ropes of silk leading to the nests were to be observed on the trunks of the trees. The injury was so great in some places that parties feared it would be followed by the death of the trees. This is far from the case with both wild cherry and apple, as was evidenced by the development of a good second crop of leaves subsequently.

The caterpillars complete their growth the latter part of May or early in June, deserting the trees and spinning the familiar whitish cocoon in almost any available shelter. The moths fly from about the middle of June till the middle of July and deposit their dark brown egg belts on the smaller twigs. The eggs usually remain unhatched until the following spring. An examination of local conditions at Nassau shows that there are an unusually large number of eggs upon the trees at the present time, and as a consequence serious injury is probable another season. This caterpillar is easily distinguished from the related forest tent caterpillar by the broad, white stripe down the middle of the back and the large, silken webs invariably constructed in the forks of the trees. The outbreak described above is one of the irregularly periodic oscillations of insect life and may continue for another year or two.

The ravages of this pest are greatly facilitated by farmers generally allowing wild cherry trees to grow along roadsides and fences. The keeping of the brush cut in all such places would not only relieve the adjacent land of an unnecessary drain but prove an important factor in controlling this common pest. It is perhaps

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needless to add that thorough and early spraying with a poison, such as arsenate of lead, for the control of the codling moth will prevent serious injury by the apple tent caterpillar.

Resplendent shield bearer (Coptodisca splendoriferella Clem.). Oval, whitish or yellowish, flattened objects less than 1/8 an inch long, may frequently be observed in midsummer, during the winter or in early spring upon the branches and trunks of apple trees. These are the cases of this insect, a species which is widely distributed and occasionally abundant though rarely injurious. It was commonly present last August in the orchard of Mr J. P. Van Ness, East Greenbush. The small caterpillars of this insect mine the apple leaves and form an irregular, dark colored blotch upon the foliage. The full-grown caterpillar cuts away the upper and lower walls of its mine, fastens them together to form a secure retreat and then crawls slowly to branch or trunk, the affected leaf having a somewhat characteristic oval hole, both extremities of which are usually pointed. The adult is about three thirty-seconds of an inch long. The head is nearly concealed by a dense tuft of golden scales, while the brown antennae are trimmed with silvery white scales. The latter are also numerous on the thorax and the base of the wings, though here they have a golden reflection. The distal part of the wing is remarkable for its striking coloration, there being irregular areas covered with golden yellow scales, a transverse band broken near the middle of silvery white scales and margined on either side with dark brown scales. On the posterior margin of the wing and extending nearly to its tip as well as near the apical middle part of the wing there are relatively large areas covered with rich dark brown scales. The posterior margin of the wing and the extremity are fringed with long, pearly gray scales. The hind wings are a rich deep gray margined with a long, yellowish brown fringe. The legs are clothed with silvery and light brown scales. There are two broods yearly, the moths appearing in May and again in July and August. This insect, though small, is preyed upon by a parasite. We have yet to observe a case where this species was sufficiently numerous to cause material injury and remedial measures are therefore inadvisable.

Apple leaf miner (Tischeria malifoliella Clem.). The trumpet-shaped mines of this common apple insect were exceedingly abundant in mid-August in the orchard of Mr J. P. Van Ness of East Greenbush. This insect is common though rarely numerous enough to cause material injury. The owner informs us

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that there had been no spraying since 1900, at which time an effort was made to destroy forest tent caterpillars with a contact insecticide. The work of this apple enemy is easily recognized by its trumpet-shaped mine which commences as a glistening spot where the egg was laid, continues for a short distance as a narrow line, gradually expanding and then suddenly widens into an irregular expanded portion. The mine is on the upper side of the leaf and when old, turns brown and is scarcely seen from the under surface. It is inhabited by a greenish, footless, active caterpillar. The upper and lower walls of the mine are densely lined with silvery white silk forming a winter retreat for the larva, which latter transforms in the spring to the pupa at one end of the mine and in a short time forces its way partly out through the upper surface of the mine and then the moth emerges.

This species appears on the foliage so late in the season that comparatively little injury is caused and, as a rule, remedial measures are unnecessary. One method of controlling this insect in case of necessity is to burn the fallen leaves which, as stated above, contain larvae or pupae, and thus reduce the number of insects another season. Spraying the foliage in summer with 10 to 15 per cent kerosene emulsion has also proved of value in destroying the larvae in their mines.

Palmer worm (Ypsolophus ligulellus Hüb.). The small, pale green or yellowish green, active, striped caterpillars of this species aroused much interest in 1900 because of their extreme abundance in orchards in Genesee county. This insect ordinarily escapes attention and, prior to the above mentioned outbreak, had scarcely been noticed subsequent to 1853. Palmer worm larvae were rather generally present the latter part of June 1912 in orchards in and about Byron and were found in small numbers upon apple trees at Nassau. Apples with freshly eaten irregular holes were noted near caterpillars, and one was found in a position which suggested that it had just been feeding upon the fruit.

The full-grown caterpillar is about half an inch long and is then usually of a pale green or yellowish green color with a dusky, subdorsal line. The head may be either yellowish or blackish. Though there is considerable variation in color the larva is not difficult to recognize, since it is very active and drops much in the same manner as does the canker worm when disturbed. Leaves partly skeletonized by this insect soon turn brown, curl and present an unsightly, ragged appearance. It is interesting to note that the

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increasing numbers of this species correspond with the greater abundance of the forest tent caterpillar, Malacosoma distria Hübn. This latter insect, it may be recalled, was extremely abundant and injurious about 1900 and reports received for the past season indicate that it is again becoming numerous.

Palmer worm caterpillars appear to be somewhat resistant to arsenical poisons, though this may be explained in part possibly by their feeding upon leaves or portions of leaves likely to be missed when spraying. Furthermore, comparatively little of the insecticide adheres to the fruit, and once under the skin the caterpillar has nothing to fear from poisons. There are good reasons for believing that thorough spraying with arsenate of lead for the control of the codling moth will at least prevent the Palmer worm from becoming sufficiently abundant to cause serious injury.

Pear midge (Contarinia pyrivora Riley). This European pest became established in this country about 1877 and has been known as a pear enemy in the vicinity of Albany for a number of years. Its injuries are extremely local and usually confined to a small number of trees, as will be seen from the following record. An examination of a beurre bosc pear tree about three days after the blossoms had fallen resulted in finding young larvae at the base of the pistils or in adjacent cavities which they had excavated. The larvae were semitransparent and only about 1 mm long. The infested fruit could be easily distinguished at that time by its being about one-half larger than the normal pears and decidedly more globular. Mr Thomas Albright of West Coxsackie states that the midge had seriously injured the fruit on this tree for a number of years and also had been more or less destructive on adjacent trees. The pear tree favored by the midge showed a large percentage, possibly 75, infested by the midge larvae. It is located near a fence and in sod, while others which were much less seriously affected were in cultivated land. It is possible that the lack of cultivation may be an important factor in enabling the midge larvae to hibernate successfully. On May 27th the larger size and more globular shape (plate 10, figures 1, 2) of the infested pears was still apparent though the fruit was beginning to be slightly lopsided, a development prior to its



Fig. 11 Section of beurre bosc pear showing crevice beside pistils (original)

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cracking and the escape of the larvae. The maggots at this time were more than twice the size they were six days before, ranging from 1.25 mm to about 2 mm in length. They were yellowish white and appear much more active than earlier. The breastbone was quite distinct, the anterior margin being well chitinized.

Doctor Schmidberger, who studied this insect in Europe, states that he found midges laying eggs as soon as the white petals showed between the lobes of the calyx, the petals being pierced by the long ovipositor. Only four days, according to his observations, were necessary between deposition of eggs and the finding of young larvae in the fruit. An examination of a young pear shows that the eggs can be deposited near the middle of the developing fruit if the female midge simply reaches down between the pistils and the thickened fleshy walls of the small pear. Mr Albright states that the beurre bosc, Bartlett and seckel pears are injured in about the order named, and an examination shows that the former two have a somewhat larger cavity at the base of the pistils. The larvae doubtless begin work at the bottom of the cavity and with comparatively little effort make their way into the developing fruit upon which they subsist. June 3d a few of the beurre bosc pears received from Mr Albright were in fair condition, several were in such a state that a little pressure resulted in rupture, while in one or two the decay had advanced so far as to involve and discolor a portion of the external walls. It was only a question of a few days before many of the affected pears would rupture and the larvae escape. The full-grown maggots were at this time about 3 mm long, moderately stout, whitish or whitish orange and with a well-developed breastbone. The subsequent escape of the maggots from the infested fruit depends much upon climatic conditions, being greatly hastened by rain which results in the speedy cracking of the infested fruit. Specimen pears received from Mr Albright June 6th showed a black discolored area on one side and in a few instances this extended nearly around the pear, and in

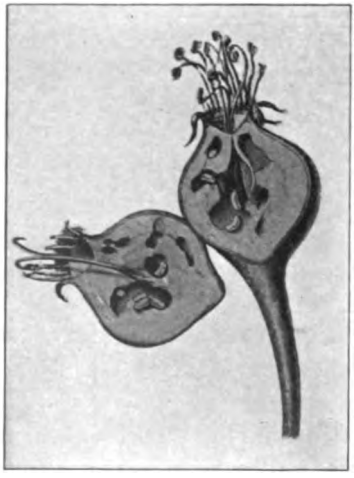


Fig. 12 Section of pear injured by pear midge (original)

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one case included the entire fruit. The larvae were full grown and a number had deserted the pears.

Owing to the local habits of this midge and the ease with which the infested fruit can be recognized, it is probable that one of the best and most effective methods of keeping this insect in control would be the early picking and destruction of the infested pears. This would involve no loss, since the fruit attacked by the midge can not develop. The only expense would be that attendant upon the collection and destruction of the young pears, a comparatively small item in the case of young trees and one which would doubtless become quite insignificant if this treatment was systematically followed year after year.

FOREST INSECTS

Forest tent caterpillar (Malacosoma disstria Hübn.). Reported injuries by this insect in 1911 led us to notice the species briefly and call attention to the possibility of its becoming more numerous this season or within a year or two. Some twenty acres of standing oak were defoliated at Bridgehampton, according to P. B. Matthews, while Messrs Isaac Hicks & Son reported under date of June 6th injury to oak on the Godfrey place in Old Westbury. The characteristic larvae were somewhat abundant though not destructive at Nassau. Specimens were received the latter part of June from A. E. Norman, Fillmore, Allegany county, while a number of reports were received from Adirondack localities. Prof. C. L. Williams observed the insect, though not excessively abundant, in the vicinity of Glens Falls. Mr A. N. Robson recorded it as present in increasing numbers at Lake George. There was serious injury to forest trees, probably by this species, at Ausable Forks according to George Chahoon, and the same was presumably the case at Jay, since Mr F. O. Bartlett reported extended defoliation, a portion of which was probably due to this species, since it was recorded as numerous in that locality the preceding year. Miss Bertha L. Paddock, Franklin Academy, Malone, observed the caterpillars feeding upon maple, mountain ash and hornbeam.

It would appear from the tenor of reports received from widely separated localities, that this insect is becoming more abundant, and it is possible that there may be extended injury another season. The probability of severe injury can be accurately forecast by examining hard maple twigs in particular and noting the relative abundance or scarcity of egg masses. This can be done easily from

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the ground if one has good eyesight, though a powerful field glass is of material service. As noted elsewhere, egg masses of the apple tent caterpillar are unusually abundant in one section and it would not be surprising if investigations showed the same was true of the forest tent caterpillar. Apple trees in the vicinity of forests are particularly likely to be injured in case there is an outbreak. An early spraying with arsenate of lead, using at least 2 pounds to 50 gallons of water, would be advisable under such conditions for the purpose of destroying the hosts of young caterpillars before material injury results.

Locust leaf miner (Chalepus dorsalis Thunb.). Serious injury by this species was observed at Syosset and in that vicinity in August and September 1911, the beetles confining their operations largely to trees less than 30 feet high. An allied form, the rosy Hispa, C. nervosa Panz., was associated with and, in certain localities at least, more abundant than the parent of the locust leaf miner. The depredations of last season were continued this year, though in early July there was practically no injury by the beetles. Full-grown larvae of the locust leaf miner were then common in locust leaves and a few adults were observed. There were no signs of the allied C. nervosa. Early in August a totally different condition of affairs prevailed. The leaves of many of the larger trees, especially the apical ones, were brown, a condition due almost entirely to the feeding of the beetles. The latter were extremely abundant, two, four, six and even eight occurring on individual leaflets, the larger number being in the more sheltered situations. The small trees were more seriously affected than the larger ones, and from reports received subsequently it was evident that serious injury was inflicted. The extensive feeding at this season is evidently followed by the beetles going into hibernation, since there seems to be but one generation annually in this section. A more detailed account of this insect is given in our preceding report, New York State Museum Bulletin 155, pages 59–63. Serious injury by this insect was also recorded at Locust Valley by the Rev. William M. Cook.

It is evident from observation of local conditions that thorough spraying with an arsenate of lead the latter part of July or early in August, at the time the beetles begin feeding upon the foliage, would result in protecting the trees from serious injury. This treatment can be advised only for the more highly prized trees on lawns or possibly along roadsides.

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Bronze birch borer (Agrilus anxius Gory). The destructive work of this pest at Lansingburg, northern Troy, was recorded last year and observations the present season show that the tops of the infested trees have succumbed. Furthermore, this borer is well established in the southern part of Troy and in Washington park, Albany. It is probably becoming well distributed in this section, and the history of white birches in recent years in the western part of the State may be shortly duplicated in the Hudson valley.

The signs of injury are well marked and are first evidenced by the thin foliage and dying condition of the upper branches. A more detailed examination may result in finding well-marked annular ridges around some of the smaller branches, frequently accompanied by reddish or rusty brown spots here and there on the white bark, indicating the operation of a borer beneath. This can be confirmed by cutting into the tree, especially where there are ridges and disclosing in the inner bark or sapwood a flattened, usually more or less sinuous channel. The only practical method of controlling this insect is to cut out and burn all affected wood prior to early May, since the beetles appear the latter part of that month or early in June and may then attack other trees. A more detailed account of this insect is given in the writer's report for last year.

Pine bark borer (Ips pini Say). This medium size to small bark borer is one of the most destructive of these forms in this section. An examination of conditions in the outskirts of Schenectady resulted in finding many dead white pines here and there in groves. They almost invariably had succumbed to attacks by this bark borer and the operations of its allies. The dead pines seen here and there had been killed earlier, while some showing needles were nearly dead and still others were found to be very badly infested though there was no appreciable change in the character of the foliage. The latter trees had the inner bark fairly riddled the last of August with the longitudinal galleries of the beetles and the irregular transverse expanding burrows of the grubs. Practically the only external evidence of the injury at that time was inconspicuous particles of brown or white sawdust thrown out by the beetles as they were entering the trees, and an occasional pitch tube. The latter is about a quarter of an inch high and in diameter and is made by the beetle bringing out particles of pitch and piling them around the point of entrance. The presence of pitch tubes is indisputable evidence of the beetles attacking living

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trees. At this time there were under the bark many grubs, numerous pupae and a few recently transformed beetles. Some of the beetles were about ready to desert the tree and it was evident that most of the others would leave the trunk within a week or two and attack some adjacent tree. Observations in 1900 showed that about eight weeks were necessary to complete the life cycle, so there was a fair chance of the recently emerging beetles attacking other trees and their progeny attaining maturity before they would be obliged to suspend activities because of approaching cold weather.

There has been a material increase in injuries to trees by bark borers during the past decade or more. Hundreds of pines, most of them magnificent specimens, have succumbed to these insidious enemies in the near vicinity of Albany. It is probable that the excessive droughts and extremely low winter temperatures of recent years have had an important effect upon many trees and resulted in lowering their vitality and probably making conditions more favorable for insect attack. These changes have, furthermore, been accentuated in suburban sections by the cutting out of many trees and the sudden exposure of previously shaded trunks to full sunlight. These factors have probably had an important effect upon insects habitually preying upon the trees.

The recognition of the causes may make it possible, in some measure at least, to avoid trouble in the future. It is obviously impossible to bring about speedy changes in climatic conditions, nevertheless the general adoption of a program which would result in the reforestation of areas now producing very little or nothing, should eventuate in welcome changes. Well-distributed, thrifty forest areas would tend to reduce the violence of our floods, mitigate the extremes of temperatures and conserve much needed moisture for the midsummer months. This would result in better growing conditions for our trees and enable them in turn to resist more successfully their insect enemies.

There is no practical method of destroying this bark borer if it has become well established in the tree, unless possibly in the case of highly prized pines standing upon lawns or private grounds. The important fact to recognize is that infested trees are not only doomed but may produce millions of beetles which will speedily attack others in the vicinity. The preservation of pines now remaining must depend in large measure upon the recognition of bark borer injury at an early stage and the prompt destruction, preferably by burning, of at least the bark with its contained insects. All should understand that the most dangerous pines, so

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far as adjacent trees are concerned, are those which show little or no discoloration of the foliage and very few exit or "shot holes," since these are the trees which contain the largest number of destructive borers. Pines which died the preceding year or earlier, while infested more or less by other borers, are not a menace to living trees. Furthermore, if satisfactory results are to be obtained by cutting out and destroying infested pines, it is essential that there should be cooperation on the part of all, since the bark borers fly readily for considerable distances.

Platypus punctulatus Chap. Numbers of this Central American borer were taken last August on Panama logs which had been shipped around the Horn and were then in the lumber yard at Astoria. The beetles were coming out in large numbers and attacking freshly sawn sappy mahogany in the yards, running longitudinal and, in some instances, vertical galleries into the wood. It was estimated that the injury in early August was as high as $200 a day. Another Ambrosia beetle, namely, Xyleborus torquatus Eich., was also taken in some numbers on the mahogany logs. With the above were associated species of Aulonium bidentatum Fabr., Xuthia brevipes Sharp and Palorus melinus Herbst. The Scolytids were kindly identified by Doctor Hopkins through the courtesy of Doctor Howard, while the other Coleoptera were determined by Doctor Schwarz, both of Washington.

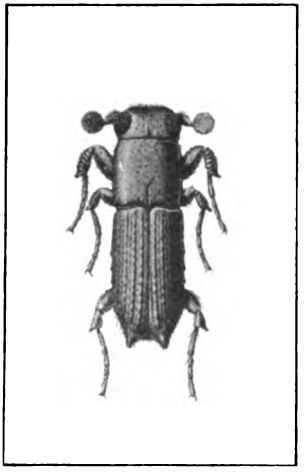


Fig. 13 Dorsal view of Platypus punctulatus, x 7½ (original)

Pine bark aphid (Chermes pinicorticis Fitch). Early in July our attention was called to some eight or nine large pine trees in the western end of Albany. These pines were very badly infested by this bark louse, the upper portion of the trunk and the under side of the larger limbs being nearly covered with the white cottony excretion. One tree was dead, probably having succumbed to earlier attacks, while a second was in a dying condition. An examination of the latter showed that various borers had begun work under the thicker bark, and that in all probability the tree would die before the end of the season. It is possible that these trees, as in the case of park trees observed in earlier years, may

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have had their vitality reduced somewhat by unfavorable conditions, not exempting very severe droughts and extremely low winter temperatures. These, however, must be considered only as predisposing factors, since the primary injury appears to have been caused by this insect. The conditions observed the past season have been duplicated in earlier years in Albany and vicinity. This aphid is also injurious to pine seedlings and has been observed on balsam. Fortunately it is very liable to attack by our various species of ladybeetles which are undoubtedly of material assistance in keeping it in control.

The aphid winters as yellowish brown eggs well protected by a copious, waxy secretion, the young appearing in the latitude of Albany from the middle to the latter part of May. The full-grown female is dark grayish purple and about one-thirty-second of an inch long.

It is very probable that this pest can be controlled satisfactorily by a forcible spray of cold water which would wash off large numbers of the insects. Experiments have shown that thorough spraying with a kerosene emulsion, the standard formula probably diluted with 9 parts of water, was very effective when the application was made in May. It is probable that a whale oil soap solution, using 1 pound to 4 gallons of water would be equally satisfactory. In either event the spray should be coarse and forcible so as to drive the insecticide through the woolly protective matter and bring it into contact with the underlying insect.

MISCELLANEOUS

Hawthorn sawfly (Trichiosoma tibialis Steph.). A cocoon of this European species was received April 10, 1911 through the State Department of Agriculture. The specimen was removed from Crataegus which had been imported from Holland. The adult was reared and the provisional identification confirmed. A badly crushed cocoon, apparently of the same species and taken from rose sticks imported from England, was transmitted for identification by the Commissioner of Agriculture November 27, 1912.

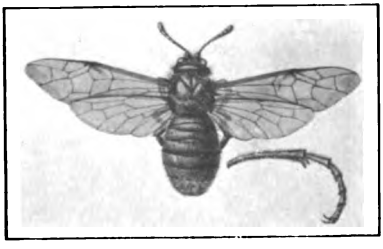


Fig. 14 Hawthorn sawfly (original)

This insect is closely allied to the native elm sawfly, Cimbex americana Leach, a species which is rather common in New York State and is found especially

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upon elm and willow. This European sawfly is about half the size of the Cimbex referred to above and may be recognized by its nearly uniform, black color and the dull rufous tarsi. The body is about three-quarters of an inch long, the wing spread one and one-half inches; the head, thorax and the base of the abdomen are thickly and irregularly clothed with rather long, tawny hairs. The general characteristics of the adult are shown in the accompanying figure.

The cocoon is about three-quarters of an inch long, subcylindric, with rounded ends, the posterior usually being narrowly so. The walls of this cocoon are composed of yellowish or tawny, matted silk more or less covered with foliage. The insect escapes by forcing off a lid at the broadly rounded anterior extremity.

The young larva, according to Cameron, has a black head and a green body, the color usually being concealed by a powdery, whitish excretion. The full-grown larva is bright greenish yellow with a darker dorsal line. The yellowish head has a large, brownish orange mark on the vertex. The legs are pale whitish green, the claws brown and the spiracles reddish. The skin is covered with minute warts and sparsely dusted with a white powder.



Fig 15 Cocoon of hawthorn sawfly (original)

The hawthorn is given as the preferred food plant, though judging from the synonomy it also occurs upon birch. We have followed Gillanders in the use of tibialis as the specific name, though Cameron assigns this, together with leucorum Westw. and crataegi Br. & Zad. as synonyms of betuleti Klug. Owing to this species being restricted in its food plants to species of relatively small economic value, it is hardly likely that it could become, even if established, a serious pest in America.

Neuroterus saltatorius Hy. Edw. A white oak leaf bearing numerous specimens of this interesting gall, a globose, unilocular swelling less than 1 mm in diameter and on the under side, was received under date of July 24, 1912 from Mr R. M. Taylor, instructor in pathology, Michigan Agricultural College, Ann Arbor, Mich: Mr Taylor called attention to the snapping or jumping habit of the galls, and careful listening enabled us to detect a low snapping or crackling, evidently due to the activity of the insect within the gall. This was easily demonstrated at a distance of an inch or

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two from the ear, and in spite of the fact that the specimens had been in press a week before they were forwarded. Mr Taylor also stated that these galls, when laid upon the table, jumped around more or less as a result of larval activities. The single chamber in the gall, according to Mr Taylor, contains a large, white, legless larva, its anterior extremity being attached to the inner wall. This species has been reported from New York State, though the identity of the eastern gall with the Californian deformity originally described by Mr Edwards is questioned (see William Beutenmueller, Amer. Mus. Nat. Hist. 1910, 28:125).

Two-spotted ladybeetle (Adalia bipunctata Linn.). This small ladybeetle was extremely abundant on a Norway maple at Nassau, which appeared to be only moderately infested with Chaitophorus aceris Linn. Scattering colonies of this plant louse were to be seen upon most of the lower leaves at least, and the grubs of this ladybeetle were commonly found, there being on July 7th, two or three partly grown grubs or pupae on most of the lower leaves. The injury by the plant louse was so reduced that there was practically no dropping of leaves in spite of the extremely dry weather of the last three weeks or thereabouts. This ladybeetle was also abundant though not quite so evident on apple and cherry trees, both of which were somewhat infested by plant lice.

This beneficial form was likewise quite abundant June 10th at Mount Vernon. One sugar maple was seen with seven or eight pupal skins or pupae on one leaf. A Norway maple in Washington Park, Albany, observed the 11th, had many of these beneficial insects upon the leaves, one, two or more grubs on individual leaves being not uncommon.

Two-spotted Anomala (Anomala binotata Gyll.). A specimen of this southern form, listed as occurring in New Jersey and Indiana, was taken in Albany from a box of presumably New Jersey strawberries. This species has not been recorded from New York State, though it may possibly occur in the extreme southern or southwestern section. This record is of interest mainly as an illustration of the effect commerce may have upon the distribution of insects.

Mosquito control. The interest in this phase of applied entomology continues, the shore communities being especially active. The village of Rye, as a result of the excessive abundance of salt

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marsh mosquitos in 1911, contracted with a company for the thorough drainage of the salt meadows and such upland territory as afforded natural breeding places for mosquito larvae. The work on the salt meadows, we are informed by a local correspondent, proved particularly effective and throughout the entire village mosquitos were very scarce during the season. The scanty rainfall of the early summer was also of service in that breeding pools remained small, and though the drainage work was not completed until September, a marked decrease in the number of mosquitos was observed. The expense of this work was $4250. This was met in part by subscription, the village contributing $2000 from the tax budget.

Other shore communities in New York State have obtained striking benefits as a result of systematic drainage, which latter involves a moderate annual expenditure for the maintenance of the ditches in good condition. The value of this work, owing to the migratory habits of the common salt marsh mosquito, is greatly increased if it be made general throughout a section where such breeding conditions obtain. The pioneer work of communities along this line can not be indorsed too highly and should serve as a marked stimulus to those adjacent. There is no question as to the practicability of eliminating almost entirely the mosquito nuisance, even in the immediate vicinity of salt marshes. The village of Lawrence, with salt marshes almost contiguous on three sides of the residential section, is a striking example of what may be accomplished by systematic and thorough work. The material benefits accruing from such undertakings will become more evident with the progress of time and we confidently expect that within a few years mosquito-ridden salt marshes and the almost intolerable mosquito nuisance will be found only near a few unprogressive communities.

Cotton moth (Alabama argillacea Hübn.) The remarkable flight of this insect in 1911 was duplicated in considerable measure the present season, though in some localities the moths were not so numerous as a year ago. The first record of the season we have is September 18th, based on an observation made by Mr E. P. Van Duzee at Buffalo. Mr Bird reports the largest number at Rye, Westchester county, from October 8th to 12th. The moths were seen by a number of competent observers in widely separated sections of the State between October 10th and 12th and later. The fresh, unrubbed condition of the insects was noted by several,

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and this, in connection with the nearly simultaneous appearance of thousands in localities remote from any known food plant, would seem explainable only by the moths rising in hosts from the cotton fields and drifting hundreds of miles in the upper air before alighting.

Detailed records from New York localities are given below:

Richmond county. Mr William T. Davis records the appearance of some moths October 11th, and on the 12th stated that they were quite abundant about the lights at St George Ferry Landing on Staten island.

Westchester county. Mr Henry Bird states that the moths appeared in the largest numbers October 8th to 12th, though at no time did they appear to be so numerous as last year. He first observed a few scattering moths October 3d, their numbers increasing daily up to the 11th, at which time they appeared to be present in maximum numbers. They displayed a marked preference for well-ripened Concord grapes, a little jarring of the trellis being sufficient to flush a cloud of moths from the vines, to which they would promptly return. Most of the specimens were in perfect condition and in shady woodlands he observed them flying considerably during the day. The local flight, as observed by Mr Bird, was of short duration and extended but a few yards. The last examples observed at Rye were seen on October 15th.

Orange county. Mr Bird states that at Middletown numbers were observed on October 14th and he was informed that they had been more numerous for two or three days previous. They seemed to be more abundant than at Rye and were in evidence until the 22d.

Otsego county. Prof. I. P. Bishop of Buffalo advised us that he learned of the appearance of the cotton moth in thousands about October 10th at Index. The moths were reported as being so numerous that it was necessary to sweep them from the slippery railroad tracks.

Ontario county. Prof. P. J. Parrott of the Geneva station states that the cotton moths were exceedingly abundant at Geneva October 10th and 11th, being so numerous as to collect in the gutters to the depth of about three to four inches near the coke and gas works on the eastern side of the city. He also adds that they appeared on the same dates at Canandaigua.

Monroe county. The moths were extremely abundant at Rochester, according to press reports based upon an identification by Prof. P. J. Parrott of Geneva.

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Genesee county. Press dispatches record the appearance of millions of these moths at Batavia before daylight on October 12th. They were so numerous that merchants were credited with having "swept them from the sidewalks and sides of their stores in basketfuls."

Chenango county. Mr Harry J. Mosher, New Berlin, October 11th, forwarded specimens which appeared in great numbers. Mr Miller states that they were seen about five o'clock in the morning, as near as he could ascertain. "Earlier risers found underneath an arc light at the very center of the village, on the ground, a solid mass of these millers or moths, several inches in depth and covering a space at least a rod across. The adjoining buildings and trees were also literally brown with them."

Wyoming county. Mr M. S. Baxter reports the presence of the moths at Warsaw.

Livingston county. Prof. G. W. Bailey of the State Normal School, Geneseo, forwarded a moth under date of October 9th, with the statement that he saw from fifteen to twenty under an arc lamp. He reports that on October 11th thousands of the insects were found on Main street, they were being swept from windows and walks, and a great number were observed resting on trees, windows and even in the street. He adds that they were practically limited to two lights at the south end of the town, only a few occurring at four other lights farther up town. The specimens seemed to be in perfect condition.

Erie county. The first cotton moths observed in Buffalo were seen by Mr E. P. Van Duzee on September 18th. They were most abundant October 11th, when many windows of the down-town stores were well covered with the insects. Mr Van Duzee had never seen so many of this species before. Mr M. S. Baxter, 75 State street, Rochester, also reported an abundance of this moth in Buffalo on October 10th. Prof. I. P. Bishop of the State Normal School, Buffalo, reported the appearance of this moth at Buffalo October 11th, stating that as many as one hundred could be counted upon a window. Mr Bishop found the flight limited in considerable measure to certain sections of the city, namely, Main street from the harbor to North street with stray individuals farther north and for two blocks either side of Main street for the greater part of the same distance; near the harbor, west of Main street and on Exchange street near the New York Central and Erie stations; in the vicinity of Niagara street and the city line, and also in the northwest part of the city. A few, he states, were reported from Depew.

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City Forester H. B. Filer reported the appearance of large numbers of the moths on the afternoon of October 10th, the insects being present in large numbers the following day, the next two days and disappearing for the most part by the 13th and 14th. He states that they seem to come with a southeast wind along with a rain storm, and were so numerous that the gutters of the lower part of Main street were literally covered with dead insects.

Niagara county. Mr M. F. Burke, assistant inspector of the State Department of Agriculture, observed this moth to be very numerous in the city of Lockport at about the same time it was so extremely abundant in Buffalo, namely October 10th to 12th.

Albany county. A few specimens of this moth were observed on the office window October 12th and the presence of the moth was reported from other parts of Albany. The specimens seen were in perfect condition.

Schenectady county. Mr Richard Lohrmann saw the first specimen at Schenectady on September 18th, the next on the 23d, swarms appearing October 7th to 12th, and the last individual was noted on October 17th. The shop windows of the General Electric Light Company were covered with the moths, though not very many were noted about the street lights.

Otsego county. Specimens were received October 15th from Oneonta through the courtesy of Mr G. G. Atwood of the Department of Agriculture.

Saratoga county. Mr H. T. Wakely of Corinth states that the cotton moth made its appearance there in thousands on the evening of October 11th. They were abundant on the 12th and ceased flying on the 13th though one was taken alive on the 16th.

Clinton county. Prof. G. H. Hudson of the State Normal School has kindly placed at our disposal his records relative to the earlier appearance of the cotton moth at Plattsburg. The data are tabulated below:

1886 September 28, 4 specimens
1886 September 29, 1 specimen
1891 October 7, 1 specimen
1891 October 13, 1 specimen
1893 September 19, 1 specimen
1893 September 20, 1 specimen
1893 September 22, 1 specimen
1893 September 23, 2 specimens
1893 October 10, 1 specimen

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Professor Hudson adds that he has not been able to look for the insect since 1893, though he believes it to be a rather regular visitor. Apparently it was not abundant in that section last October.

The flight of the cotton moth was closely followed in some localities by the appearance of numerous specimens of the lime tree winter moth, Erannis tiliaria Harr., a species mistaken by some for the cotton moth. This latter form was reported by Mr E. P. Van Duzee as unusually abundant at Buffalo on October 22d. It was numerous around the electric lights of Schenectady in the week of October 10th, according to Richard Lohrmann. Numerous specimens were also observed about the same time in different sections of Albany. The same phenomenon, though perhaps not to such a marked extent, was noted by Henry Bird at Rye.

Southern captures. In connection with the record given above relating to the large flights of the cotton moth, Alabama argillacea Hübn., we deem it advisable to place on record the capture by Mr Henry Bird at Rye of the following three species of southern Noctuids: Autographa oxygramma Geyer, Anomis erosa Hübn. and Anticarsia gemmatilis Hübn. Mr Bird states from observations covering a period of twenty-eight years, that he has not previously noted these insects in that locality.

Periodical Cicada (Tibicen septendecim Linn.). The appearance of a large brood of this insect in 1911 aroused much interest, and as an indirect outcome, we received from Prof. G. A. Bailey June 11, 1912, a report that he had found several nymphs of this insect emerging from the ground on Major Wadsworth's estate at Geneseo. Subsequently adults were forwarded and there can be no question as to the identity of the insect. Professor Bailey states that the few observed occurred within a narrow radius in a piece of second growth timber. There is a record of a colony of brood 12, the one which appeared in such large numbers in the Hudson valley in 1911, in the northern part of Pennsylvania and not so very distant from Geneseo. Should the insects noted above belong to this brood they must be considered as stragglers, otherwise it is necessary to associate them with brood three, no colony of which has been recorded nearer New York State than central-western Ohio and the northern portion of West Virginia. This seems to be a weak colony, since we have been unable to obtain any information respecting the earlier appearance of the insect in that section.

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The occurrence of belated individuals is amply substantiated by records kindly placed at our disposal by Mr W T Davis of New Brighton, who found periodical Cicadas on Staten island in 1895 and again in 1912. They were likewise found the past season by Mr Davis at West Point. In all cases they were undoubtedly belated individuals from the brood which appeared in such large numbers in 1894 and 1911. Mr Davis has also collected specimens of this brood in 1893 and 1910, one year in advance of the normal time for emergence. Mr Henry D. Lewis of Annandale informs us that no belated individuals were observed by him in 1912, though he had seen them following earlier appearances of this insect.

Juniper bug (Pentatoma juniperina Linn.). This large, green, reddish or pinkish margined stinkbug is comparatively rare in New York State. It was found in unusual numbers on small pines at North Chatham May 11, 1912, eight to ten occurring on individual trees only three to four feet high. The insects did not seem to be feeding. They had evidently recently emerged from hibernation and were associated with specimens of Brochymena and Euschistus.

Mite migration. An interesting specimen of Helobia punctipennis Meign., a small fly only about three-sixteenths of an inch long, was taken at Albany June 25, 1911. The abdomen of this specimen bore six relatively large mites, several of them ranged one behind the other in a regular series. This mite was submitted to Doctor Howard for determination and identified by Mr Banks as a Gamasid belonging to the genus Seius and probably undescribed. Mr Banks points out that these mites were probably upon the fly for migratorial purposes and were not parasitic, despite the fact that mites are frequently observed upon insects and commonly supposed to be parasitic.

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PUBLICATIONS OF THE ENTOMOLOGIST

The following is a list of the principal publications of the Entomologist during the year 1912. The titles,[1] time of publication and a summary of the contents of each are given. Volume and page numbers are separated by a colon.

Dying Hickory Trees. Auburn Advertiser, November 3; Buffalo Commercial, Middletown Argus, New York Tribune, November 5; Geneva Times, Lockport Union-Sun, Ossining Citizen, Watertown Standard, Schenectady Star, Amsterdam Recorder, November 6; Glens Falls Times, Catskill Mail, Rome Sentinel, November 7; Greenwich Journal, Yonkers News, Oxford Times, November 8; Phoenix Register, Peekskill Union, Norwich News, Perry Record, November 9; Cortland Standard, Randolph Register, Rensselaer Eagle, Tioga County Record, November 10; Saratoga Eagle, Yonkers Gazette, November 11; Kingston Freeman, November 17; Catskill Examiner, Pelham Sun, Brooklyn Times, November 18; Washington County Post, November 24, 1911

The characteristic work of the hickory bark borer, Eccoptogaster quadrispinosa Say, is described and the destruction of infested wood during the winter advised.

Codling Moth. New York State Department of Agriculture, Bulletin 28, 1911, pages 237–50 (issued December 14, 1911). Reprinted as Circular 40

A summarized discussion of Carpocapsa pomonella Linn. and methods of control in the light of recent experiments.

New Species of Gall Midges. Economic Entomology Journal, 1911, 4:546–59

The following new species are described: Leptosyna quercus [quercivora], Asphondylia eupatorii, A. thalictri, Uleella [Bruggmaniella] mexicana, Contarinia spiraeina, Dicrodiplosis coccidarum, D. gillettei, Mycodiplosis carolina, M. coccidivora, M. cucurbitae, M. spinosa, Youngomyia quercina, Y. vernoniae, Hyperdiplosis fungicola, Parallelodiplosis clarkeae, Cecidomyia cerasiphila, C. hopkinsi, Itonida cucurbitae, I. spiraeina, I. taxodii, I. pugionis, I. cincta and I. canadensis.

[1] Titles are usually given as published. In some instances articles appearing in a number of papers have been given different titles by the various editors.

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The Seventeen-year Locust. American Year Book, 1911. 1912, pages 498–99

Summary account of the 1911 appearance of the periodical Cicada, Tibicen septendecim Linn.

The Identity of the Better Known Midge Galls. Ottawa Naturalist, 1912, 25:164–67, 181–88

Lists some of the earlier described species of Lasioptera, Neolasioptera, Asteromyia, Rhabdophaga and Dasyneura.

Biology of Miastor and Oligarces. Science, February 16, 1912, 35:278–80

A summarized account giving the American distribution, recognition characters and observations on the biology and natural enemies.

Bronze Birch Borer. Garden Magazine, February, 1912, 15:36

A summary statement of injuries with a discussion of control measures for Agrilus anxius Gory.

Control of Insect Pests in Institutions. Journal Home Economics, February, 1912, 4:16–26

A general discussion of the more important household insect pests with special reference to their control in institutions.

Shade Tree Prospects. Middletown Times, Albany Times Union, New York Tribune, March 11; Glens Falls Times, Knickerbocker Press, March 12; Syracuse Journal, Greenwich Journal, March 13; Washington County Post, March 22; Schenectady Gazette, March 30; Troy Press, April 4, 1912

The serious injury by the elm leaf beetle, Galerucella luteola Müll., the preceding year is briefly characterized and thorough spraying urged.

Fight Against Codling Moth. Rural New Yorker, March 16, 1912, 71:355, 393, 395

Summary account of experimental work and methods of controlling this pest.

Save the Trees. Troy Budget, March 17, 1912, page 24

A general discussion of the shade tree situation with special reference to methods of controlling the elm leaf beetle.

Save the Hickories. Troy Times, March 30; Glens Falls Times, April 1; Utica Herald Dispatch, April 2; Ogdensburg Journal, Auburn Advertiser, Lockport Journal, Poughkeepsie Union, Amsterdam Recorder, April 3; Warwick Advertiser, Ithaca

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Journal, April 4; Binghamton Press, Poughkeepsie Eagle, Syracuse Herald, April 5; Albany Sunday Telegram, April 7; Hudson Falls Herald, Schenectady Gazette, April 11; Cortland Standard, April 17; Catskill Recorder, Suffern Recorder, April 19, 1912

The characteristic work of the hickory bark borer, Ecccoptogaster quadrispinosa Say, is described and the prompt destruction of infested trees urged.

Early Leaf Feeders. Knickerbocker Press, April 4; Utica Observer, April 6, 1912

The work of the early leaf feeders, such as the apple tent caterpillar, the canker worms, the bud moth and the case-bearers, is briefly described and remedial measures advised.

Spraying Apples. Utica Press, Knickerbocker Press, April 11; Utica Observer, Albany Argus, April 12; Watertown Herald, Yonkers Herald, Rome Sentinel, April 13; Binghamton Herald, Troy Times, April 15; Orange County Record, Yates County Chronicle, Cortland Standard, April 17; Washington County Post, Plattsburg Press, April 19; Poughkeepsie Eagle, April 20; Hoosick Falls Democrat, Penn Yan Express, April 24; Cobleskill Index, April 25; Catskill Recorder, Waterloo Observer, April 26; Hudson Falls Herald, May 2; Ithaca Journal, May 3; Warwick Dispatch, May 8; Oswego Gazette, May 9, 1912

The results from one thorough spraying with arsenate of lead are summarized and arsenate of lead, 2 pounds to 50 gallons of water and a pressure of 125 to 150 pounds or more, advised.

New West Indian Gall Midges. Entomological News, April 1912, 23:173–77

The following species are described: Uleella [Bruggmaniella] pisoniae, Mycodiplosis pulvinariae, Arthrocnodax meridionalis and Hyperdiplosis producta.

Practical Methods in Controlling the Codling Moth. Western New York Horticultural Society Proceedings, 1912, pages 74–82

A summary discussion of the results obtained in 1909–11.

Spraying for Codling Moth. New York State Fruit Growers' Association Proceedings, 1912, pages 190–97

General summary of experimental work in 1909–11, with special reference to Hudson valley conditions.

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Recent Experiments with the Codling Moth. Economic Entomology Journal, 1912, 5:153–59

A summary discussion of experimental work.

Lasiopteryx manihot n. sp. (Diptera) Canadian Entomologist, 1912, 44:144

Original description of a species reared from Cassava, Manihot utilissima.

Pear Thrips. Albany Journal, May 4; Catskill Mail, May 6, 1912

Injuries by this pest are noted and spraying with a tobacco soap preparation advised.

Plant Lice—A Warning. Troy Times, Ossining Citizen, Middletown Times, Utica Herald Dispatch, May 4; Knickerbocker Press, Times Union, Yonkers Herald, May 6; Schenectady Star, Oneonta Star, May 7; Warwick Dispatch, Penn Yan Express, May 8; Fonda Democrat, Utica Press, May 9; Suffern Recorder, Madison County Times, Penn Yan Democrat, Randolph Register, Oneida Dispatch, Rensselaer County Standard, Catskill Recorder, Poughkeepsie Eagle, May 10; Saratoga Eagle, May 11; New York Tribune, May 13; Watkins Review, May 15; Hudson Gazette, May 16; Hudson Falls Register, May 23, 1912

A warning notice advising early and prompt spraying before aphids become excessively abundant.

Control of Elm Leaf Beetle. Schuylerville Democrat, May 15, 1912

A somewhat extended discussion of the fundamentals involved in the satisfactory control of this insect.

Spraying Elms. Albany Journal, Troy Record, May 21; Troy Press, Saratoga Sun, Times Union, Knickerbocker Press, May 22; Catskill Mail, Hudson Register, May 23; Troy Times, Catskill Enterprise, May 25, 1912

Thorough spraying of the elms is urged and at least 4 pounds of arsenate of lead to 50 gallons of water advised.

Spraying Apparatus. Schenectady Star, May 28, 1912

A brief discussion of the cost and relative advantage of various types of spraying apparatus. Villages and municipalities should obtain as good results spraying as tree protecting firms. Arsenate of lead is advised as the best poison.

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Insects and Shade Trees. The American City (New York) May 1912, 6:731–32

A summary discussion of the shade tree problem in the northeastern United States.

Forest Tent Caterpillar. Albany Journal, June 3; Schenectady Star, Glens Falls Times, Troy Record, Newburg News, June 4; Middletown Argus, Albany Argus, June 5; Keeseville News, Rensselaer County Standard, June 7; Fort Plain Free Press, June 11; Port Jervis Gazette, June 12; Warwick Advertiser, Fulton County Democrat, June 13; Catskill Recorder, June 14; Utica Advocate, June 15; Binghamton Herald, June 19; Warrensburg News, Massena Observer, June 20, Owego Gazette, June 27, 1912

A warning notice in regard to possible depredations by this insect.

27th Report of the State Entomologist on Injurious and Other Insects of the State of New York. New York State Museum Bulletin 155, pages 1–198, plates 27 (issued June 13, 1912)

Contents

	Page		Page
Introduction	5	Experiments with heat as an insecticide	93
Injurious insects	13	Notes for the year	98
Codling moth	13	Fruit tree insects	98
Gipsy moth	42	Small fruit insects	102
Green maple worm	48	Shade tree pests	104
Iris borer	52	Forest pests	110
Notch wing	54	Miscellaneous	114
Maple leaf cutter	56	Publications of the Entomologist	124
Locust leaf miner	59	Additions to collections	130
Rosy Hispa	63	Explanation of plates	137
Rose leaf hopper	65	Index	191
Periodical Cicada	68		
A report upon the condition of the shade trees of the city of Mount Vernon, N. Y.	88		

Diarthronomyia californica n. sp. Pomona College Journal of Entomology, 1912, 4:752

Description of a midge reared from subconic leaf galls on Artemisia californica.

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Observations on the Identity of the Wheat Midge. Economic Entomology Journal, 1912, 5:286–8

Prodiplosis fitchii and Itonida tritici are described as new. A detailed description is given of Thecodiplosis moselana Gehin.

Anthrenus verbasci. Economic Entomology Journal, 1912, 5:297

Records the continued breeding of this insect in dried corn for a period of ten years.

Priority vs Nomina Conservanda. Science, July 5, 1912, 36:17–18

A general discussion with special reference to the Itonididae. Adherence to the strict law of priority is urged.

The Fundamentals of Spraying. New York State Department of Agriculture Bulletin 37, pages 1413–20, 1912

A summary discussion of materials and methods.

Elm Leaf Beetle and White-marked Tussock Moth. New York State Museum Bulletin 156, pages 1–35, plates 8, 1912 (issued July 11, 1912)

Contents

	Page		Page
Introduction	5	Remedial measures	11
Elm leaf beetle	6	White-marked tussock moth	14
Results of attack	7	Description	15
Food plants	7	Life history and habits	15
Distribution	7	Food plants	16
Description	8	Natural enemies	16
Life history	9	Remedies	16
Natural enemies	10	Explanation of plates	19
Preventive measures	10	Index	35

New Itonididae. New York Entomological Society Journal, 1912, 20:102–7

The following new species are described: Campylomyza truncata, Corinthomyia gracilis, Johnsonomyia cincta, Asynapta americana, Camptomyia aestiva, Porricondyla vernalis, P. dietzii, P. porrecta, Dasyneura eugeniae and Youngomyia pennsylvanica.

Itonida inopis O. S. Economic Entomology Journal, 1912, 5:368–69

A general biologic account with descriptions of all stages.

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White Grubs. Knickerbocker Press, August 16; Kinderhook Courier, August 22, 1912

A brief record of severe injury in southern Rensselaer and northern Columbia counties, with observations upon their habits and methods of control.

Scraping Trees. Guide to Nature, August 1912, 5:13

The common practice of scraping the rough bark from shade trees is considered of practically no benefit.

Damage By White Grub and the Chinch Bug. Albany Evening Journal, October 2; New York Farmer, October 10, 1912

A summary account of injury by the white grub, with suggestions for reseeding, and a notice of an outbreak by the chinch bug, Blissus leucopterus Say.

Some Large Problems in Economic Entomology. Cornell Countryman, October 1912, No. 1, pages 3–7

A general discussion of entomological problems, with special reference to the need of national quarantine and the desirability of protecting shade and forest trees from insect depredations. Data are given regarding the number of insects, their varied stages and food habits and the difficulties attendant upon the recognition of the numerous forms.

Observations on Uleella Rübs. Entomological News, 1912, 23: 353–54

The characters of the adults of this genus are established and U. pisonifolia described in both sexes, together with the gall, larva and pupa.

New Gall Midges or Itonididae. New York Entomological Society Journal, 20:146–56, 1912

Several midges are recorded from spiders' webs and the following species described: Coccidomyiaerii Oligotrophus betheli, Janetiella coloradensis, Asteromyia grindeliae, Lasioptera verbenae, L. diplaci, Asphondylia diplaci, A. enceliae, Thecodiplosis zauschneriae, Clinodiplosis araneosa, Coquillettomyia knabi and Karschomyia townsendi.

Scientific notes. Economic Entomology Journal, 5:398, 403, 411, 1912

Brief notes on outbreaks by white grubs (Lachnosterna species), fall army worm, Laphygma frugiperda Sm. & Abb. and the locust leaf miner, Chalepus dorsalis Thunb.

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Arthrocnodax occidentalis n. sp. Economic Entomology Journal, 5:402, 1912

Original description of a midge reared from red spider, Tetranychus.

ADDITIONS TO THE COLLECTIONS, OCTOBER 18, 1911–OCTOBER 15, 1912

The following is a list of the more important additions to the collections:

EXCHANGE

There were received from Dr Otto Nüsslin, Zoologisches Institut, Karlsruhe, Germany, two or more specimens of each of the following species:

Eccoptogaster scolyta Fabr., E. ratzeburgi Janson, E. carpini Ratz., E, multistriata Marsh, Hylastes ater Payk., Dendroctonus micans Kugl., Myelophilus piniperda Linn., M. minor Hartig., Hylesinus crenatus Fabr., H. fraxini Panz., H., vittatus Fabr., Polygraphus polygraphus Linn. Crypturgus cinereus Herbst., Ips sexdentatus Boern., I. acuminatus Gyllh., I. curvidens Germ., I. laricis Fabr., Pityogenes chalcographus Linn., P. bidentatus Herbst. and Xyleborus saxeseni Ratz.

There were received from Prof. J. M. Aldrich, Moscow, Idaho: Ephydra hians Say, adults pupae and larvae; E. gracilis Pack, adults; E. subopaca Lw., adults; E. millbrae Jones, adults; Caenia bisetosa Coq., adults.

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DONATION

Hymenoptera

Thalessa atrata Fabr., black long sting, adult, June 17, G. C. Lewis, Lockport

Apanteles congregatus Say, cocoons and adults, July 29, Arthur Dummett, Mount Vernon. Same, cocoons on Ampelophaga myron Cram., August 7, E. W. De Long, Crown Point

Cynips strobilana O. S., lobed oak gall, October 12, W. L. McAtee, Pickens, Miss.

Andricus seminator Harr., wool sower, gall on white oak, June 21, C. C. Laney, Rochester. Same, June 24, Miss Ruth H. Sherman, Glens Falls

Neuroterus saltatorius Hy. Edw., galls on white oak, July 24, R. M. Taylor, Ann Arbor, Mich.

N. umbilicatus Bass., oak button gall on Quercus michauxii, October 12, W. L. McAtee, Pickens, Miss.

Cimbex americana Leach, elm sawfly, larva on elm, September 20, Miss E. S. Blunt, New Russia

Tremex columba Linn., pigeon tremex, adult, September 11, A. G. Woodard. Through State Conservation Commission

Caliroa cerasi Linn., pear slug, larvae on pear, August 12, E. C. Brooks, Athens

Kaliofenusa ulmi Sund., elm leaf miner, larva on elm, June 13, A. N. Robson, Lake George. Same, June 15, Neil Rutledge, Greenwich. Same, June 19, W. L. Devereaux, Syracuse. Same, larvae and work on elm, June 24, J. G. Ward, Cambridge

Trichiocampus viminalis Fall., larvae, August 29, Harry Vail, New Mulford

Coleoptera

Eccoptogaster quadrispinosa Say, hickory bark beetle, work on hickory, February 9, W. J. Matheson, Huntington. Same, larvae and work, March 12 and June 17, H. W. Merkel, New York City. Same, work, June 22, E. H. Anderson, Scarsdale. Same, adults and work, July 1, J. J. de Vyver, Mount Vernon. Same, work, July 30, F. P. Dwyer, Yonkers

E. multistriata Marsh, imported elm bark borer, work, adults and larvae, October 5, J. W. Chapman, Dorchester, Boston, Mass.

Pissodes strobi Peck, white pine weevil, work on pine, July 11, Ferruccio Vitale, New York City

Thricolepis simulator Horn, gray, bark-eating weevil, adult on apple, May 2, Thomas Cunningham, Vancouver, B. C.

Pomphopoea sayi Lec., Say's blister beetle, adults on wild cherry, May 31, C. J. Herrick, Elsmere

Coptocycla ? clavata Fabr., larva on morning glory, July 9, G. H. Hawley, Castleton

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Galerucella luteola Müll., elm leaf beetle, adults, April 18, M. H. Gardner, Brewster. Same, May 10, Mrs W. H. Crittenden, Cornwall. Same, eggs on elm, June 14, J. T. Young, Watervliet. Same, adults, larvae and pupae on elm, July 11, A. Gaskell, Ellenville. Same, larvae and work on elm, July 16, L. A. Tate, Gloversville. Same, work on elm, August 5, W. M. Cook, Oyster Bay

Glyptoscelis alternata Cr., leaf beetle, adult on apple, May 2, Thomas Cunningham, Vancouver, B. C.

Elaphidion villosum Fabr., oak and maple pruner, larva and work on oak, July 24, Mrs J. O. Rooney, Scarsdale

Monohammus confusor Kirby, sawyer, adult, July 10, Chatham Courier, Chatham. Same, adult on pine, July 17, Mrs George Wend, Albany

Lachnosterna, June beetle, larva in grass sod, August 11, Mrs Matthew Bender, jr, Niverville. Also from W. M. Woodward, North Chatham

Psephenus lecontei Lec., larva, September 25, R. M. Moore, Rochester

Dermestes vulpinus Fabr., leather beetle, all stages, March 26, W. G. Van Name, Albany

Megilla maculata DeG., spotted ladybeetle, adults, December 13, Charles Bernstein, Rome

Diptera

Thecodiplosis ananassi Riley, galls on cypress, September 12, W. L. McAtee, Marksville, La.

Caryomyia caryae O. S., gall on hickory, July 22, G. L. Dale, Mount Kisco. Same, July 24, Mrs J. O. Rooney, Scarsdale

Caryomyia persicoides Beutm., on hickory, July 24, Mrs J. O. Rooney, Scarsdale

Contarinia pyrivora Riley, pear midge, larvae on pear, May 27, Thomas Albright, New Baltimore

Asphondylia betheli Ckll., male, female, larva and pupa on Opuntia, April, C. F. Baker, Claremont, Cal. Same, gall, male and female on Cactus, May 22, E. Bethel, Denver, Col.

Simulium sp., blackfly, larvae, June 19, W. D. Rhines, Linlithgow

Eristalis tenax Linn., bee fly, larvae, August 27, Charles Bernstein, Rome

Musca domestica Linn., housefly, larvae from cases of Myiasis interna, September 9, J. R. Gillett, Kingston

? Agromyza sp., adult on Wisteria buds, March 23, E. O. Amundsen, San Diego, Cal.

Lepidoptera

Polygonia ? comma Harr., hop merchant, eggs on hop, June 5, Principal, Schoharie High School, Schoharie. Through State Department of Agriculture

Euvanessa antiopa Linn., spiny elm caterpillar, larva on elm, June 25, Mrs I. D. F. Delafield, Greenport. Same, July 1, J. A. Sweigert, Comstock

Sphecodina abbotii Swain, larva on woodbine, July 10, J. H. Dodge, Rochester. Same, July 29, Arthur Dummett, Mount Vernon

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Ampelophaga myron Cram., grapevine hog caterpillar, larva on grape, August 7, E. W. De Long, Crown Point

Samia cecropia Linn., Cecropia moth, cocoon, December 28, H. Gaut, Glen Cove

Telea polyphemus Cram., American silk worm, eggs, June 6, Mrs A. M. A. Jackson, Warner

Callosamia promethea Dru., Promethea moth, cocoons, May 10, Miss M. R. Wilbor, Old Chatham. Same, larvae on lilac, August 5, Mrs Martha W. Martin, Albany

Diacrisia virginica Fabr., Virginia ermine moth, adult, June 20, A. E. Worman, Fillmore. Through State Conservation Commission

Arctia caja Linn., garden tiger moth or woolly bear of Europe, larva, October 26, L. F. Strickland, Lockport. Through State Department of Agriculture

Alypia octomaculata Fabr., eight-spotted forester, larva on woodbine, July 10, C. C. Woolworth, Castleton

Laphygma frugiperda Sm. & Abb., fall army worm, larvae and pupae on lawn, September 11, Robert Mostow, New York City; Roy Latham, Orient Point; Samuel Parsons, New York City, also September 21

Agrotis ypsilon Rott., black cutworm, larva, June 10, T. F. Niles, Chatham

Mamestra picta Harr., zebra caterpillar, larvae on pear, July 16, F. E. Rogers, Oswego

Papaipema appassionata Harvey, P. necopina Grt., P. frigida Sm., P. sciata Bird, P. inquaesita G. & R., P. maritima Bird, P. rigida Grt., P. marginidens Gn., P. moeseri Bird, P. duplicata Bird, P. cerussata Grt., P. duovata Bird and Apamea erepta, var. graminea Bird. Contributed by Henry Bird, Rye, August 14

Alabama argillacea Hübn., cotton moth, adults, October 9, G. W. Bailey, Geneseo. Same, October 11, H. J. Mosher, New Berlin. Same, October 13, I. P. Bishop, Buffalo

Catocala sp., caterpillar, June 19, A. H. Green, Shushan

Datana integerrima Grt. & Rob., black walnut worm, larvae on English walnut, August 5, M. T. Richardson, New York City. Same, caterpillars, August 22, C. H. Smith, Mohegan Lake

Schizura concinna Sm. & Abb., red-humped apple caterpillar, larvae on apple, July 9, J. W. Wiltse, North Chatham

Tolype laricis Fitch, larch lappet moth, larva, August 8, J. H. Dodge, Rochester

Malacosoma americana Fabr., apple tent caterpillar, larvae, June 12, T. L. Coventry, Utica. Same, larvae on oak, June 19, P. B. Matthews, Bridgehampton. Through State Department of Agriculture. Same, adult, July 7, Whitcomb of the Commonweal, Greenwich. Same, cocoons, July 13, George Chahoon, Ausable Forks

M. disstria Hübn., forest tent caterpillar, larvae, June 10, Isaac Hicks & Son, Westbury. Same, larvae, June 20, A. E. Worman, Fillmore. Through State Conservation Commission

Erannis tiliaria Harr., basswood inch worm, larvae on elm and basswood, June 8, G. C. Vosburgh, Moravia

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Thyridopteryx ephemeraeformis Haw., bagworm, larvae on purple beech, August 2, Miss Helen A. Brown, Brooklyn

Sibine stimulea Clem., saddleback caterpillar, September 3, G. R. Felten, Cementon. Same, larva on blackberry, September 24, J. B. Mulholland, Kingston

Zeuzera pyrina Linn., leopard moth, work on hickory, October 26, Isaac Hicks & Son, Westbury. Same, larva, December 24 and 27, E. T. Mulligan, New York City. Through State Department of Agriculture. Same, larva, March 17, Miss Mary L. Lobdell, Woodhaven

Mineola indigenella Zell., leaf crumpler, larval cases, February 24, C. L. St John, Canajoharie

Ephestia cautella ? Walk., larvae and adults on English walnuts, November 20, Ogden Stevens, Albany

Evetria ? frustrana Comst., caterpillar on pine, August 30, W. F. Smith, Valhalla

E. ? comstockiana Fernald, pitch twig moth on pine, June 12, H. T. Fernald, Amherst, Mass.

Tmetocera ocellana Schiff., bud moth, larvae in pear buds, May 8, R. Scofield, Coeymans

Tortrix fumiferana Clem., spruce bud moth, larvae on spruce, June 3, G. E. Emmons, Schenectady

Coleophora caryaefoliella Clem., larvae and work on hickory, July 13, F. M. Weld, New York City

Bucculatrix canadensisella Cham., birch leaf skeletonizer, molting cocoons, August 29, Cadwallader Evans, Stellarton, Nova Scotia. Also, larvae, cocoons and work on birch, September 18

Phyllonoryter hamadryella Clem., oak blotch leaf miner, mines on oak, July 29, David Harrison, Staatsburgh. Same, work on oak, August 5, Miss Anne R. Wier, Garrison

Gracilaria near violacella Busck, larvae on azalea, March 7, D. Clark's Sons, Fordham Heights, New York City. Through State Department of Agriculture

Neuroptera

Corydalis cornuta Linn., horned Corydalis, adult, July 1, I. L. Nixon, Rochester

Thysanoptera

Euthrips pyri Dru., pear thrips, adults on apple, May 1, G. E. Ward, Ravena

Hemiptera

Tibicen septendecim Linn., seventeen-year cicada, adult and pupal case, June 14, G. A. Bailey, Geneseo

Cicada ? linnei Grossb., harvest fly, adult, August 26, J. H. Dodge, Rochester

Phylloxera caryaecaulis Fitch, hickory gall aphid, old galls on hickory, October 26, A. B. Buchholz, Geneva. Through State Department of Agriculture

Chermes pinicorticis Fitch, pine bark aphid, adults on pine, July 5, H. N. Armer, Ballston Spa. Through State Conservation Commission. Same, July 12, W. P. Judson, Broadalbin. Same, August 8, M. F. Duhamel, Poughkeepsie

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Hormaphis hamamelidis Fitch, witch-hazel cone gall, galls on witch-hazel, August 5, A. M. Baker, Oneonta

Pemphigus populi-transversus Riley, gall and young on poplar, June 18, Mrs R. S. Banks, Albany

Schizoneura americana Riley, woolly elm leaf aphis, young on elm, June 18, C. E. Olsen, Maspeth. Same, adults and young on elm, June 21, Miss Alice C. Hareford, Watertown. Same, adults and work on elm, July 18, A. R. Fuller, Malone

S. lanigera Hausm., woolly apple aphis, young on apple, November 8, Mrs S. H. Niles, Coeymans. Same, nymph on apple, August 26, J. A. Delehanty, Albany

Chaitophorus aceris Linn., work and young on Norway maple, July 6, D. T. Marshall, Hollis. Same, nymphs on Norway maple, July 11, W. W. Gibson, Watervliet

Callipterus ulmifolii Mon., elm leaf aphis, adults on elm, July 1, R. S. Waterman, Ogdensburg

Mindarus abietinus Koch., work on balsam, July 1, G. L. Barrus, Paul Smiths

Aphis nasturtii Kalt., adults and nymphs on nasturtium, October 3, Roy Latham, Orient Point

Gossyparia spuria Mod., elm bark louse, males and females on elm, May 29, J. G. Brock, Binghamton

Eriococcus borealis Ckll., adults, October 7, T. D. A. Cockerell, Boulder, Col.

Phenacoccus acericola King, false maple scale, males on maple, June 11, Samuel Hessberg, Albany

Trionymus violascens Ckll. (part of type), adult on Agropyron, October 2, T. D. A. Cockerell, Glenwood Springs, Col.

Pseudococcus citri Risso, mealy bug, adult, July 20, C. E. Olsen, Maspeth

Pulvinaria vitis Linn., cottony maple scale, adults and young on soft maple, July 6, D. T. Marshall, Hollis

Lecanium sp., Lecanium scale, adult and young on Tecoma radicans, November 1, Tioga County. Through State Department of Agriculture. Same, adults on oak and chestnut, June 8, E. E. Carpenter, Morris

Asterolecanium variolosum Ratz., golden oak scale, adult, June 14, Woodlawn Cemetery, New York City. Through State Conservation Commission

Toumeyella liriodendri Gmel., tulip tree scale, young on tulip tree, February 12, J. H. Livingston, Tivoli. Same, adults on tulip, July 29, A. G. Harris, North Pelham. Same, July 29, Miss Annis E. Thomson, Yonkers

Eulecanium ? canadense Ckll., adults on elm, May 27, S. M. Clark, Warrensburg

E. ? persicae Fabr., peach scale, adults and eggs on crimson rambler rose, June 17, Silvanus Van Aken, Port Ewen. Same, July 2, Mrs Robert Lown, Idlewild

Chionaspis furfura Fitch, scurfy scale, eggs, March 5, J. Heavey, Buffalo

Chionaspis americana Johns., elm scurfy scale, egg on elm, February 6, J. J. Levison, Brooklyn

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C. pinifoliae Fitch, pine leaf scale, egg on Austrian pine, February 6. J. J. Levison, Brooklyn. Same, adults on pine, September 16, Mrs Harriet A. Duff, Kinderhook

C. spartinae Comst., grass scale, on Spartina glabra alterniflora, November 11, Roy Latham, Orient Point

Diaspis carueli Targ.-Tozz., juniper scale on juniper, May 16, Rochester. Through State Department of Agriculture

Aspidiotus pernicious Comst., San José scale, young, March 5, J. Heavey, Buffalo. Same, May 24, C. L. Williams, Glens Falls

A. ancylus Putn., Putnam's scale, half grown, April 19, D. D. Stone, Oswego

Chrysomphalus aonidum Linn., rubber scale insect., adults on rubber plant, April 22, Roy Latham, Orient Point

Lepidosaphes ulmi Linn., oyster shell scale, egg on willow, December 28. H. Gaut, Glen Cove. Same, eggs, March 5, J. Heavey, Buffalo. Same, old scales on apple, May 11, Fred Henkes, Watervliet. Through State Department of Agriculture. Same, young, June 22, Levi Hasbrouck, Ogdensburg. Same, adults on white birch, July 20, C. E. Olsen, Maspeth

Parlatoria theae Ckll., adult on Japanese maple, April 25, from Schenectady. Through State Department of Agriculture

Haematopinus piliferus Beurm., sucking dog louse, adults on dog, April 8, Miss Lillian C. Overton, Albany

Blissus leucopterus Say, chinch bug, adults and young, September 26, C. L. St John, Canajoharie

Acholla multispinosa DeG., spined assassin bug, nymph, August 13. Edwin Buchman, Valley Falls

Cimex lectularius Linn., bedbug, adult, May 12, G. J. Briggs, Macedon

Lygus pratensis Linn., tarnished plant bug, work on dahlia, July 17, C. L. Williams, Glens Falls

Poecilocapsus lineatus Fabr., four-lined leaf bug, adults on currant, June 19, L. F. Strickland, Lockport

Benacus griseus Say, giant water bug, adult, June 10, Roy Latham, Orient Point

Orthoptera

Diapheromera femorata Say, walking-stick, adult, August 20, Arthur Dummett, Mount Vernon

Thysanura

Lepisma domestica Packard, silver fish, adult, October 25, J. E. Stagg, Buffalo. Through State Department of Agriculture

Acarina

Eriophyes pruni Schoene, plum mite, galls on plum, July 22, G. E. Osterhout, Windsor, Col.

Phyllocoptes quadripes Shimer, bladder maple gall, galls on soft maple, June 11, G. W. Herrick, Ithaca. Same, June 24, H. N. Babcock, Elmira

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APPENDIX

A STUDY OF GALL MIDGES

The gall midges comprise an immense family of small flies or Diptera known as the Itonididae or Cecidomyiidae, represented in America by about 900 known species, approximately half having been reared from the deformities or galls they produce or matter upon which they live. The species referable to this family may be recognized by the tibiae being unarmed apically, the coxae not produced, and the wings usually with but three or four long veins and no crossveins. Extreme forms may have six or seven long veins and one crossvein or, as a result of reduction, the wing veins may be nearly absent.

There are in this family a number of important insect pests, such as the Hessian fly, Phytophaga destructor Say; the wheat midge, Itonida tritici Felt; the pear midge, Contarinia pyrivora Riley; the clover midge, Dasyneura leguminicola Lintn.; the violet gall midge, Phytophaga violicola Coq.; the rose midge, Dasyneura rhodophaga Coq.; and the grape blossom midge, Contarinia johnsoni Sling. In addition to these there are a number of other potentially injurious midges, not to mention European species, which may become established in this country at almost any time and cause serious losses in somewhat the same way as did the Hessian fly in earlier years.

Our knowledge of American gall midges was in a very unsatisfactory condition in 1895. The following discussion of the Lestremiinae and Heteropezinae comprises a systematic descriptive account of these groups.

LESTREMIINAE

The members of this subfamily are almost invariably medium to small, dark brown or black species, easily distinguished from all other Itonididae by the five tarsal segments, the metatarsus being longer than the following segment, and the presence of the fourth long vein, which latter may be either forked as in Lestremia or simple and obsolescent as in Campylomyza. The antennae may be moderate as in Lestremia and Campylomyza or extremely short as in Tritozyga and Microcerata. The circumfili, so characteristic of the higher groups, are entirely wanting in this

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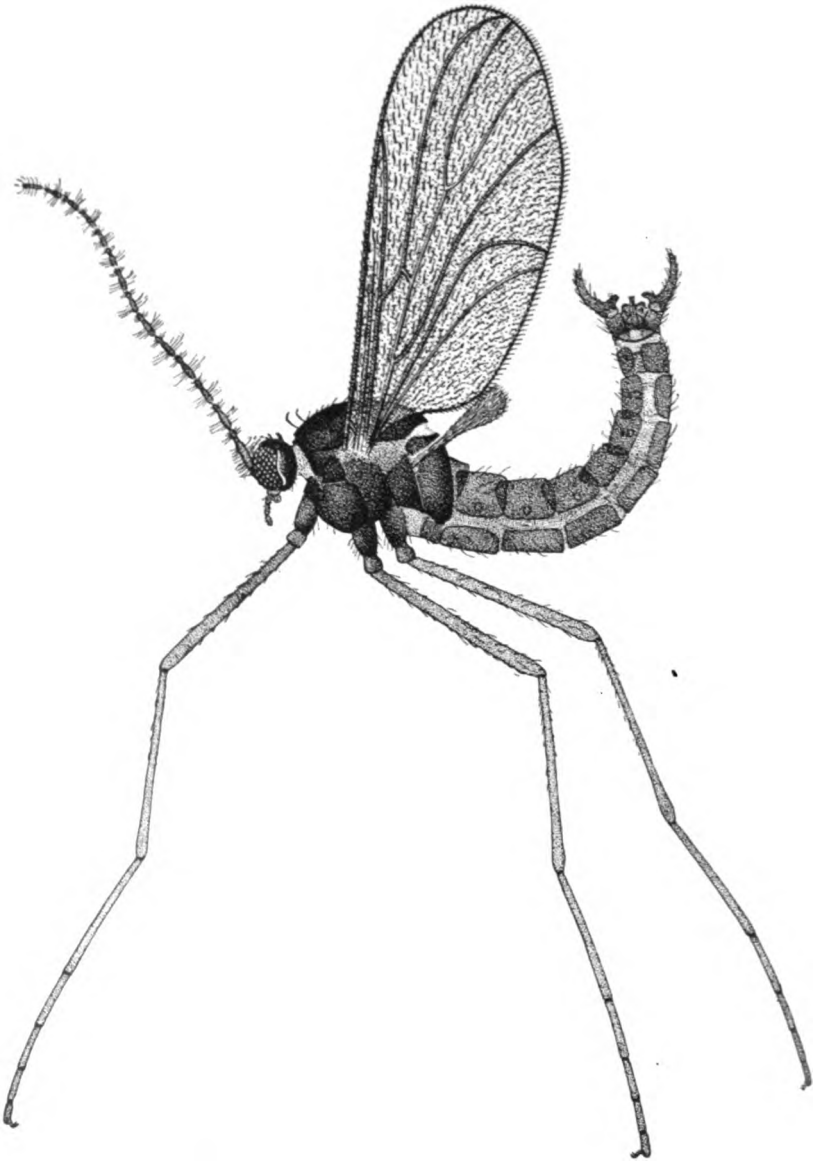


Fig. 16 Catocha americana, side view, enlarged. (original)

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subfamily. The members of this group appear to depend to a considerable extent upon the olfactory organs. Many of the species falling in this division subsist in the larval stage on dead or decaying vegetable matter.

This group is a connecting link with the Mycetophilidae from which it is most easily distinguished by the absence of tibial spurs and the moderate development of the coxae.

Lestremiinariae

The members of this tribe are separable from all other Itonididae by the forked fourth vein and by the generalized character of the antennae. These organs may be moderately well developed as in Lestremia and Catocha, or greatly reduced as in Tritozyga and Microcerata.

Key to living genera

a Antennae at least moderately developed, with 11–16 segments, the second not decidedly enlarged
b Costa continuous and extending beyond the apex of the wing..... Catocha Hal.
bb Costa not attaining the apex of the wing, practically disappearing at its union with the third vein.....Lestremia Macq.
aa Antennae greatly reduced, only 8–10 or 11 segments
b Second antennal segment greatly enlarged; flagellate segments very short
c Fork of the fourth vein with the two branches even..... Microcerata Felt
cc Fork of the fourth vein with the branches irregular..... Tritozyga H. Lw.
bb Second antennal segment normal
c Flagellate segments not greatly reduced.....Neptunimyia Felt
cc Flagellate segments sessile, with a length only a little greater than the diameter.....Neocatocha Felt

Catocha Haliday

Macrostyla Winn.

1833 **Haliday, A. H.** Ent. Mag., 1:156
1840 **Westwood, J. O.** Introduct. Class. Ins. Syn., p. 127
1846 **Rondani, Camillo.** Nouvi Ann. Sci. Nat. Bologna, ser. 2, v. 7; separate, p. 7 (Furcinerva)
1846 **Winnertz, J.** Stett. Ent. Zeit., 7:20 (Macrostyla)
1862 **Osten Sacken, C. R.** Dipt. N. Am. Mon., 1:177
1864 **Schiner, J. R.** Fauna Austriaca Dipt., 2:412
1870 **Winnertz, J.** Vehr. z.-b. Ges. Wien., 20:27–28
1876 **Bergenstamm, J. E., & Löw, Paul.** Syn. Cecidomyidarum, p. 17
1888 **Skuse, F. A. A.** Linn. Soc. N. S. Wales Proc., 3:143

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1892 **Theobald, F. V.** Acct. Brit. Flies, p. 51, 87
1895 **Kieffer, J. J.** Soc. Ent. Fr. Bull. p. 319
1897 ———— Syn. Cecid. Eur. & Alg., p. 52
1900 ———— Soc. Ent. Fr. Ann. 69:438, 443 (Furcinerva)
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 308–9
1911 ———— N. Y. Ent. Soc. Jour., 19:31

The species referable to this genus are easily recognized by costa being continuous and extending beyond the tip of the third vein, which latter unites with the margin at the apex of the wing. The fourth vein is forked, the cell usually being much shorter than in Lestremia. The antennae differ greatly from those of Lestremia, being in the male of C. americana (figure 17) distinctly binodose, while in the case of C. slossonae the segments are long, slender and distinctly stemmed. There are 16 antennal segments in the two known American species. Type C. latipes Halid. Europeans forms are recorded as having 14 to 16 antennal segments in the male and 10 to 12 segments in the female. The genitalia of our American species are of a quite different type from that found in Lestremia.

Nothing is known concerning the life history of American forms. Kieffer states that the larvae of the European C. muscicola Kieff. occur on mosses. It is probable that these forms are sylvan as in the case of Lestremia and allied genera. Our species are doubtless boreal in habitat.

Key to species

a Length 4 mm; antennae binodose, terminal clasp segment long, appendiculate basally.....americana Felt, C. 929
aa Length 4 mm, antennae uninodose, terminal clasp segment short.....barberi n. sp.
aaa Length 1.5 mm; antennae uninodose.....slossonae Felt, C. 931

Catocha americana Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 309

This species, received for study through the courtesy of the United State National Museum, was taken at Franconia, N. H., by that well-known collector, Mrs A. T. Slosson.

Male. Length 4 mm. Antennae nearly as long as the body, thickly haired, dark brown; 16 segments, the third with the basal enlargement somewhat produced, the fourth and following, each slightly binodose, the basal subcylindric enlargement with a length nearly four times its diameter (figure 17). Palpi; the first

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segment, irregularly subquadrate, with a length fully twice the diameter, the second about two-thirds the length of the first, the third more than twice the length of the second and the fourth a little longer than the third. Mesonotum dull black, the submedian lines sparsely haired. Scutellum reddish brown, postscutellum and

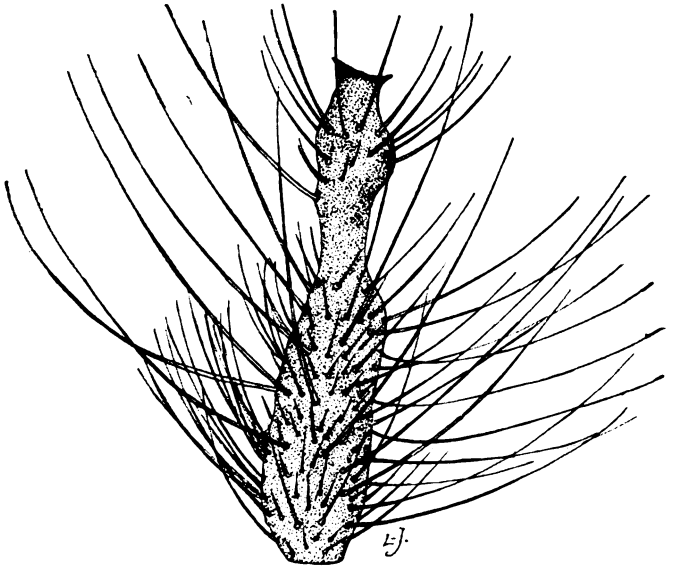


Fig. 17 Catocha americana, sixth antennal segment of male, much enlarged. (original)

abdomen dark brown. Wings hyaline, costa light brown; membrane thickly clothed with fine hairs; venation shown in fig. 16. Halteres fuscous yellowish. Legs dark yellowish brown; claws stout, with a series of three or four stout teeth basally, the pulvilli hardly extending beyond the base of the claws. Terminal clasp segment long, appendiculate basally. Type Cecid. 929.

Catocha barberi n. sp.

Two midges belonging to this species were taken flying in the woods during cold weather, the temperature being below 30° F., near Crab Lake, Vilas county, Wis., by Mr H. S. Barber, in December 1907.

Female. Length 4 mm. Antennae one-quarter longer than the body, sparsely haired, dark brown; 16 segments, the fifth with a slender stem over twice the length of the subglobose basal enlarge-

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ment, the latter with a thick whorl of long, slender setae near the middle; terminal segment reduced. Palpi; first segment narrowly oval, with a length two and one-half times its diameter, the second to fourth subequal, sparsely setose and with numerous transverse rows of short, stout spines. Head and thorax probably dark brown. Abdomen light brown. Wings hyaline. Halteres pale yellowish, the legs a variable yellowish brown; claws stout, strongly curved, the pulvilli rudimentary. Type in U. S. National Museum.

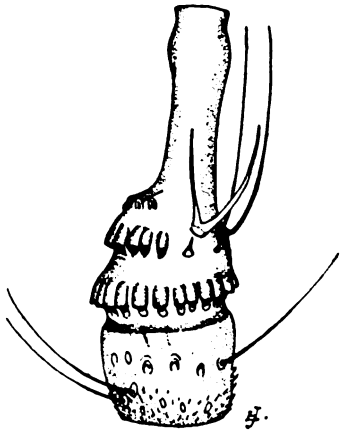


Fig. 18 Fiftl. antennal segment of Catocha slossonae, enlarged. (Original)

Catocha slossonae Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 309

This form, received through the courtesy of the United States National Museum, was taken by Mrs Slosson at Franconia, N. H.

Male. Length 1.5 mm. Antennae as long as the body, sparsely clothed with long hairs; 16 segments; the fourth with a smooth stem about as long as the subcylindric basal enlargement; near the middle a crenulate whorl of long, slender setae, apically several circular orifices and long, trilimbate processes. Palpi; the first segment presumably short, stout, subrectangular, the second rather stout, with a length about two and one-half times its diameter, the third stout, subrectangular and with a length about three-fourths greater than its diameter, the fourth tapering distally, a little longer and more slender than the third. Mesonotum shining dark brown, the submedian lines very sparsely haired. Scutellum reddish brown, postscutellum a little darker. Abdomen dark brown, the genitalia fuscous yellowish. Wings hyaline, costa light brown. Halteres yellowish transparent, slightly fuscous apically. Legs light fuscous yellowish; claws rather long, stout, the concavity finely denticulate, the pulvilli longer than the claws. Type Cecid. 931.

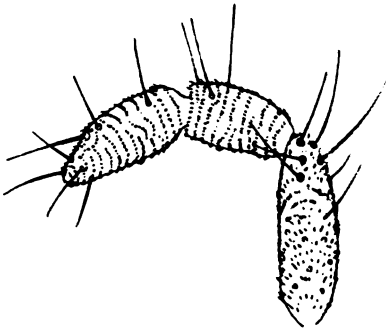


Fig. 19 Palpus of Catocha slossonae, enlarged. (Original)

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Lestremia Macq.

1826 **Macquart, J. M.** Dipt. Nord. de la France, 1, 123
1826 **Meigen, J. W.** Syst. Beschr., 5:308
1834 **Macquart, J. M.** Hist. Nat. Ins. Dipt., 1:157
1840 **Westwood, J. O.** Introduct. Class. Ins. Syn., p. 127
1844 **Loew, H.** Stett. Ent. Zeit., 5:324 (Cecidogona)
1846 **Rondani, Camillo.** Nouvi Ann. Sci. Nat. Bologna, ser. 2, v. 6; separate, p. 7 (Furcinerva), 10 (Mimosciara)
1856 ———— Dipt. Ital. Prodr., 1:198 (Yposatoea)
1860 ———— Atti Soc. Ital. Sci. Nat. Milano, 2:287 (Molobraea)
1862 **Osten Sacken, C. R.** Dipt. N. Am. Mon., 1:178
1864 **Schiner, J. R.** Fauna Austriaca Dipt., 2:413
1870 **Winnertz, J.** Vehr. z.-b. Ges. Wien, 20:30
1876 **Bergenstamm, J. E., & Löw, Paul.** Syn. Cecidomyidarum, p. 17
1888 **Skuse, F. A. A.** Linn. Soc. N. S. Wales, Proc., 3:144
1892 **Theobald, F. V.** Acct. Brit. Flies, p. 52, 87
1897 **Kieffer, J. J.** Syn. Cecid. Eur. & Alg., p. 52
1900 ———— Soc. Ent. Fr. Ann. 69:437, 442 (Mimosciara), 443 (Cecidogona, Furcinerva)
1904 **Meunier, F.** Soc. Sci. Brux. Ann. 28:9, 31
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 308, 310
1911 ———— N. Y. Ent. Soc. Jour., 19:31

This genus is easily recognized by the characteristic fork of the fourth vein, by costa not attaining the apex of the wing, and by the antennae being well developed, those of the male having 16 and those of the female 11 segments. Certain European species are credited with having 15 antennal segments in the male and 12 in the female. The antennal segments in the female are short, subcylindric or subconical and in some species at least, ornamented distally with thick rows of short, stout, chitinous sensory processes. The male antennae are provided with a distinct stem nearly as long or longer than the basal enlargement, which latter is ornamented by one or more crenulate whorls from the base of which arise long, curved setae. The genitalia are very characteristic. Type L. cinerea Macq.

Nothing is known concerning the life history and habits of members of this genus, aside from the fact that they are most abundant in the vicinity of forests. Kieffer states that the European L. leucophaea Meign. occurs in decaying beech wood and it is very probable that our American forms breed largely in rotting ligneous tissues.

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Lestremia leucophaea Meign. occurs in America according to Coquillett,[1] having been taken in the White mountains by Mrs Slosson. This identification is open to question, since the species of this genus resemble each other superficially very closely.

Key to species

a Antennal segments 11; females
b Abdomen reddish brown
c Scutellum dark brown; basal segment of ovipositor with a length fully twice its width; terminal segment small, narrowly oval and distinctly shorter than the basal segment..... elongata Felt, C. 933
cc Scutellum yellowish brown; basal segment of ovipositor broadly triangular, its length not more than one-half greater than its width; terminal segment nearly as long as the basal one, narrowly oval.....barberi Felt, C. 934
bb Abdomen fuscous yellowish
c Length 3 mm
d Terminal segment of ovipositor orbicular; claws minutely denticulate.....sylvestris Felt, a1642
cc Length 1.5 mm
d Fourth palpal segment one-quarter longer than the third; basal segment of the ovipositor one-half longer than broad..... sambuci Felt, C. 743
dd Fourth palpal segment twice the length of the third; basal segment of ovipositor a little longer than broad..... kansensis Felt, C1261
aa 16 antennal segments; males
b Stems of antennal segments two-thirds or three-quarters the length of the subcylindric basal enlargement
c Dorsal plate short, broad, triangularly emarginate, the 4 palp segments successively longer.....pini Felt, C. 562
cc Dorsal plate broad, tapering, roundly emarginate, the third and fourth palp segments not longer than the preceding..... acerifolia Felt, C. 71
bb Stems of antennal segments as long as the basal enlargement
c Basal clasp segment with a conspicuous setose basal lobe internally.....solidaginis Felt, C. 700, 633, 691
cc Basal clasp segment with no well-developed basal lobe internally
d Fourth palpal segment as long as the third
e Scutellum fuscous yellowish; dorsal plate not convolute, nearly truncate distally.....setosa Felt, Sc. 22
dd Fourth palpal segment one-half longer than the third
e Abdomen dark brown; scutellum reddish brown; dorsal plate convolute, broadly rounded distally and margined posteriorly with moderate setae.....spiraeina Felt, C. 274
ee Abdomen dark yellowish brown; scutellum yellowish brown; dorsal plate obliquely truncate distally and margined posteriorly with stout, divergent setae..... franconiae Felt, C. 930, 937

[1] 1896 Ent. News, 7:263

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bbb Antennal stem one-quarter longer than the basal enlargement

c Abdomen dark reddish brown; scutellum yellowish brown; basal enlargement of antenna with 2 crenulate whorls and with a length about twice its diameter; terminal clasp segment bidentate apically.....dyari Felt, C. 935

cc Abdomen dark brown; scutellum dark reddish brown; basal enlargement of antenna with one crenulate whorl and with a length a little greater than its diameter; terminal clasp segment acute distally.....vernalis Felt, C. 1260

Lestremia elongata Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 310

This species, received through the courtesy of the United States National Museum, was taken on the Argus mountains in May 1891.

Female. Length 3 mm. Antennae extending to the base of the abdomen, sparsely haired, dark brown; 11 segments, the fourth with a very short stem, irregularly cylindric, with a length about one-half greater than its diameter; other segments somewhat produced, the terminal one with the basal portion broadly oval and separated from the short, stout apical part, by a distinct constriction. Palpi; the first segment stout, with a length fully three times its diameter and a conspicuous sensory organ internally, the second two-thirds the length of the first, more slender, the third a little longer and more slender than the second, the fourth more than twice the length of the third, more slender. Mesonotum dull brown, the submedian lines sparsely haired. Scutellum and postscutellum dark brown. Abdomen reddish brown. Wings hyaline. Halteres pale yellowish. Coxae and femora dark reddish brown, tarsi fuscous yellowish. Ovipositor short, the terminal lobes biarticulate, the basal lobe with a length fully twice its diameter, expanding and truncate distally, the terminal lobe small, narrowly oval, both thickly setose. Type Cecid. 933.

Lestremia barberi Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 310

This species, loaned for study by the United States National Museum, was taken August 8th by H. S. Barber at Las Vegas, N. M.

Female. Length 2.75 mm. Antennae extending to the base of the abdomen, sparsely haired, dark brown; 11 segments, the fourth with a length about one-half greater than its diameter, the terminal segment produced, strongly constricted near the distal third, irregularly rounded apically. Palpi; the first segment, with a length about two and one-half times its diameter, somewhat expanded distally and with a conspicuous sensory organ on its internal face, the second about as long as the first, stout, irregularly subrectangular, the third one-quarter longer than the second, more slender, the

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fourth one-half longer than the third, more slender, dilated apically. eyes large, black. Mesonotum dark brown. Scutellum yellowish brown, postscutellum dark brown. Abdomen reddish brown. Wings hyaline. Halteres yellowish transparent. Legs dark yellowish brown. Ovipositor short, biarticulate, the basal lobe irregularly and broadly subtriangular, the terminal lobe nearly as long as the basal one, narrowly oval, both thickly setose. Type Cecid. 934.

Lestremia sylvestris Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 102; separate p. 5-6 (Catocha)

1908 ———— N. Y. State Mus. Bul. 124, p. 311

This species was taken September 23, 1906 in a forest hut at Davidson's River, N. C.

Female. Length 3 mm. Antennae extending to the second abdominal segment, sparsely haired, dark brown, basally pale yellowish; 11 segments, the fifth with a stem one-quarter the length of the basal enlargement. Palpi; the first segment somewhat curved, swollen and thickly clothed distally with stout, capitate setae, the second segment one-half longer than the first, the third and fourth each nearly twice the length of the second; face pale yellowish, eyes large, dark brown. Mesonotum dark brown, submedian lines dark yellowish, narrow, uniting posteriorly in a median dark yellowish area. Scutellum pale yellowish orange, postscutellum dark brown. Abdomen yellowish brown, incisures and pleurae pale salmon, terminal segments pale yellowish. Wings hyaline; halteres whitish transparent. Coxae pale yellowish, femora semi-transparent, tibiae and tarsi fuscous yellowish; claws with a series of minute teeth along the concavity. Ovipositor short, lobes orbicular, thickly setose. Type Cecid. a 1642.



Fig. 20 Fifth of Lestremia sylvestris, enlarged. (Original)

Lestremia sambuci Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 101-2; separate, p. 5 (Catocha)

1908 ———— N. Y. State Mus. Bul. 124, p. 311

This species was taken August 6, 1906 at Albany on elder, Sambucus canadensis.

Female. Length 1.5 mm. Antennae one-third the length of the body, sparsely haired, dark brown, fuscous yellowish basally; 11 segments, the fifth with a stem one-fourth the length of the basal enlargement, which latter has a length thrice its diameter. Palpi; the first segment broadly rounded, subquadrate, the second as long

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as the first, subquadrate, the third more slender, one-half longer and the fourth one-quarter longer than the third; face fuscous yellowish, eyes fuscous. Mesonotum reddish brown, submedian lines indistinct. Scutellum and postscutellum a fuscous reddish yellow. Abdomen fuscous yellow, membrane and pleurae lighter; ovipositor

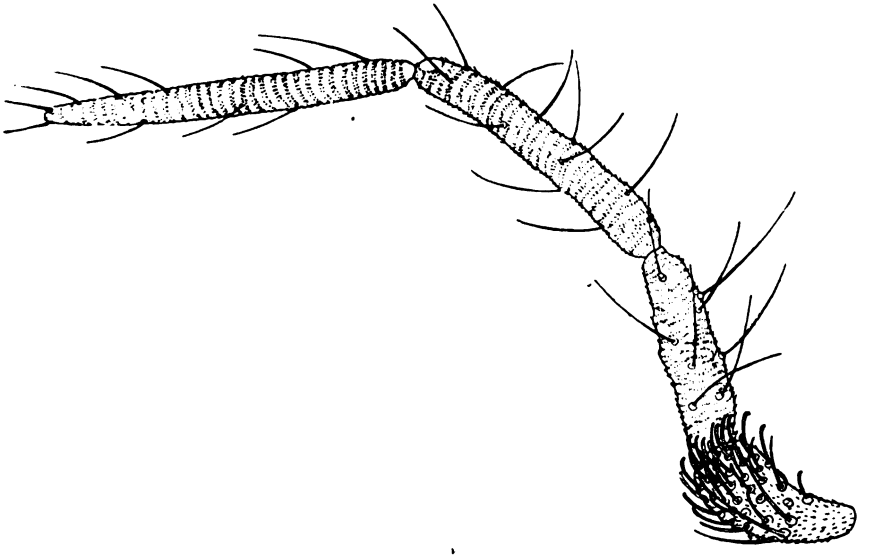


Fig. 21 Palpus of Lestremia sylvestris, enlarged. (Original)

slightly fuscous. Wings hyaline. Halteres yellowish basally, fuscous apically. Legs dark fuscous yellowish, the first tarsal segment as long as the following segments; claws apparently finely dentate. Ovipositor short, terminal lobes broadly subquadrate, slightly constricted basally, thickly setose. Type Cecid. 743.

Lestremia kansensis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 311

This species was taken in Douglas county, Kansas, by Mr E. S. Tucker in May.

Female. Length 1.5 mm. Antennae extending to the third abdominal segment, thickly haired, light brown, yellowish basally; 11 segments, the fifth with a stem one-fourth the length of the basal enlargement, which latter has a length a little over twice its diameter; terminal segment with a length about four times its diameter, distal part slender, irregularly fusiform, apically with a fingerlike process. Palpi: the first segment short, stout, narrowly oval, second segment slender, with a length one-half greater than the first, the third one-half longer than the second and more slender, the fourth about twice the length of the third, slender. Mesonotum

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dark brown. Scutellum and postscutellum yellowish brown. Abdomen fuscous yellowish, sparsely haired, ovipositor slightly fuscous. Wings hyaline. Halteres yellowish transparent. Coxae, femora and tibiae a variable yellowish brown; tarsi light reddish brown, the distal tarsal segments darker; claws simple, the pulvilli almost rudimentary. Ovipositor short, the terminal lobes biarticulate. Type Cecid. 1261.

Lestremia pini Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 103; separate, p. 7
1908 ———— N. Y. State Mus. Bul. 124, p. 311

This species was taken July 16, 1906 on pine, Pinus, at Albany, N. Y.

Male. Length 1.5 mm. Antennae probably as long as the body, sparsely haired, dark brown; 16 segments, the fifth with a stem

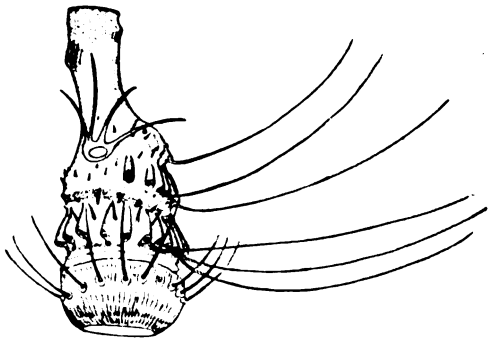


Fig. 22 Fifth antennal segment of Lestremia pini, enlarged. (Original)

three-fourths the length of the basal enlargement, which latter has annular constrictions at the basal fourth, near the middle and at the distal fourth; terminal segment prolonged basally, the stem short, narrowly conical. Palpi; the first segment short, subquadrate, the second longer, broadly oval, the third nearly twice the length of the second, stout, the fourth one-half longer than the third, slender distally, the fifth one-half longer than the fourth, slender. Mesonotum dark brown, sparsely white haired. Scutellum light brown, postscutellum yellowish brown. Abdomen grayish brown, the terminal segments darker. Wings hyaline. Halteres whitish transparent. Coxae, femora and tibiae whitish transparent, tarsi fuscous; claws with three or four long teeth. Genitalia; dorsal plate short, broad, broadly incised; ventral plate apparently fused with the preceding. Harpes long, slender, widely separated. Type Cecid. 562.

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Lestremia acerifolia Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 101; separate, p. 5 (Campylomyza)
1908 ———— N. Y. State Mus. Bul. 124, p. 311

This species was taken May 21, 1906 on soft maple, Acer, at Albany, N. Y.

Male. Length .4 mm. Antennae longer than the body, sparsely haired, dark brown; 16 segments, the fifth with a stem two-thirds the length of the obpyriform basal enlargement; terminal segment produced, irregularly subconic. Palpi; the first segment long, stout, subelliptic, the second twice the length of the first, slender, the third two-thirds the length of the second, the fourth a little shorter than the third. Mesonotum dark brown, the light submedian lines setose. Scutellum yellowish brown, postscutellum darker. Abdomen light brown. Wings hyaline. Halteres yellowish transparent. Legs mostly dark brown; claws pectinate. Genitalia; dorsal plate broad, tapering, roundly emarginate, the lobes broadly rounded; ventral plate indistinct. Harpes stout, tapering, the extremities approximate and slightly curved; style slender, distally with a pair of recurved, chitinous teeth. Type Cecid. 71.

Lestremia solidaginis Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 102; separate, p. 6 (Catocha)
1908 ———— N. Y. State Mus. Bul. 124, p. 311

This species was captured sweeping grass, sedge or Solidago at Newport, N. Y., July 25, 1906. It was also reared August 6, 1906, from a jar containing whorled loosestrife, Lysimachia quadrifolia, the latter probably an accidental occurrence.

Male. Length .75 mm. Antennae nearly as long as the body, thickly haired, dark brown; 16 segments, the fifth with a stem as long as the cylindric basal enlargement; terminal segment produced, constricted at the basal and apical thirds, an apical knob. Palpi; the first segment short, quadrate, the second broadly oval, the third a little longer, subrectangular, the fourth one-fourth longer and more slender, the fifth one-half longer than the fourth, more slender. Mesonotum dark brown. Scutellum dark carmine, postscutellum lighter. Abdomen fuscous yellowish, distal segments somewhat darker. Wings hyaline, costa dark brown. Halteres pale yellowish. Legs pale fuscous yellowish, tarsi dark brown; claws simple. Genitalia; basal clasp segment short, broad, with a rather conspicuous rounded setaceous lobe basally; dorsal plate narrowly rounded; ventral plate broad, deeply and narrowly emarginate, the lobes narrowly rounded. Harpes tapering, curving, subacute; style long, slender, acute. Type Cecid. 700.

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Lestremia setosa Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 311

This species was taken July 24, 1906 on maple at Albany, N. Y.

Male. Length 2 mm. Antennae as long as the body, sparsely haired, light brown, yellowish basally; 16 segments, the fifth with a stem as long as the pyriform basal enlargement; terminal segment produced, constricted near the distal third and apical fourth. Palpi: the first segment, short, stout, irregularly subquadrate, the second a little more slender, one-half longer, subrectangular, the third about twice the length of the second, more slender, the fourth about as long as the third, more slender; face yellowish. Mesonotum olive brown, the submedian lines broad, yellowish, poorly defined. Scutellum fuscous yellowish, postscutellum yellowish. Abdomen a light fuscous brown. Genitalia fuscous yellowish, sparsely clothed with fuscous setae. Wings subhyaline. Halteres yellowish basally, slightly fuscous apically. Legs a pale fuscous yellowish; claws simple, the pulvilli shorter than the claws. Genitalia; dorsal plate long, broad, broadly emarginate, the lobes broadly rounded. Harpes long, broad, convolute, roundly truncate; style long, slender, narrowly rounded. Type Sc. 22.

Lestremia spiraeina Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 102; separate, p. 6 (Catocha)

1908 ———— N. Y. State Mus. Bul. 124, p. 311

This species was taken June 15, 1906 on spirea at Albany, N. Y.

Male. Length 1.5 mm. Antennae as long as the body, thickly haired, dark brown, yellowish basally; 16 segments, the fifth with a stem as long as the subglobular basal enlargement; terminal segment produced irregularly, subconical, slightly constricted at the basal fourth, near the middle and at the apical fourth. Palpi; first segment subquadrate, prolonged, the second shorter, stouter, the third twice the length of the second, more slender, the fourth one-half longer than the third, slender; eyes small, black. Mesonotum dark brown, with indistinct submedian yellowish lines, sparsely setose. Scutellum reddish brown, slightly fuscous apically, sparsely setose; postscutellum reddish brown. Abdomen dark brown, rather thickly setose. Genitalia fuscous yellowish. Wings hyaline, costa and subcosta dark brown. Halteres yellowish transparent. Legs a nearly uniform pale straw, the articulations carmine; tarsi slightly darker, the first segment as long as the four following; claws stout, the concavity denticulate. Genitalia; dorsal plate broad, narrowly incised, the lobes irregularly rounded; ventral plate long, broad, triangularly emarginate, the lobes divergent, truncate. Harpes triangular, obtusely spined basally, tapering and approximate apically; style slender, narrowly rounded. Type Cecid. 274.

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Lestremia franconiae Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 311

This species, loaned by the United States National Museum for study, was taken by Mrs A. T. Slosson at Franconia, N. H.

Male. Length 1.75 mm. Antennae as long as the body, sparsely haired, dark brown; presumably 16 segments, the fourth with a stem as long as the fusiform basal enlargement. Palpi; the first segment subrectangular, with a length nearly three times its diameter and with a conspicuous sensory area distally, the second nearly twice the length of the first, more slender, the third almost twice as long as the second, more slender, and the fourth one-half longer and more slender than the third; eyes large, black. Mesonotum reddish brown. Scutellum light yellowish brown, postscutellum darker. Abdomen a dark yellowish brown; genitalia yellowish. Wings hyaline; halteres yellowish transparent. Legs a pale yellowish brown, the tarsi slightly darker; claws simple, the pulvilli distinctly shorter than the claws. Genitalia; dorsal plate long, broad, deeply and triangularly emarginate, the lobes widely divergent, broad, somewhat excavated. Harpes long, slender, swollen near the distal third, tapering, narrowly rounded; style stout, tapering, narrowly rounded. Type Cecid. 930.

Lestremia dyari Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 311

This form, loaned for study by the United States National Museum, was taken June 7th at Caslo, B. C., by Dr H. G. Dyar.

Male. Length 1.75 mm. Antennae as long as the body, sparsely haired, dark brown, yellowish basally; 16 segments, the fourth with a stem one-fourth longer than the subcylindric basal enlargement, which latter has a length twice its diameter; terminal segment with the basal portion produced, the distal stem rudimentary. Palpi; the first segment, with a length three times its diameter, the second a little longer than the first, more slender, the third about twice as long as the second, more slender, the fourth a little longer and more slender than the third. Mesonotum dark brown, the submedian lines pale yellowish. Scutellum yellowish brown, postscutellum reddish brown. Abdomen dark reddish brown, sparsely clothed with fine hairs, genitalia dull orange. Wings hyaline, costa light brown. Halteres yellowish transparent. Coxae, femora and tibiae fuscous yellowish, tarsi dark brown; claws stout, the concavity finely denticulate, the pulvilli shorter than the claws. Genitalia; dorsal plate long, broad, broadly and roundly emarginate, the lateral angles produced; ventral plate apparently absent. Harpes long, slender, tapering, narrowly rounded; setose; style stout at base, tapering, narrowly rounded. Type Cecid. 935.

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Lestremia vernalis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 311

This species was taken in April at Wichita, Kansas, by Mr E. S. Tucker.

Male. Length 1.5 mm. Antennae a little longer than the body, thickly haired, dark brown; 16 segments, the fifth with a stem one-fourth longer than the subglobose basal enlargement, which latter has a length a little greater than its diameter, terminal segment reduced, narrowly oval, obtuse. Palpi; the first segment long, rather stout, subrectangular, the second as long and more slender than the first, the third one-half longer and more slender than the second, the fourth twice the length of the third, more slender. Mesonotum dark brown, the submedian lines inconspicuous. Scutellum and postscutellum dark reddish brown. Abdomen dark brown. Genitalia dark reddish brown. Wings hyaline, costa dark brown. Halteres yellowish basally, light brown apically. Coxae, femora and tibiae fuscous yellowish, the segments irregularly brownish at the extremities; tarsi mostly light brown, the distal segments darker; claws simple, the pulvilli shorter than the claws. Genitalia; dorsal plate long, broad, broadly emarginate, the lobes separated, broadly rounded. Harpes apparently fused to form one large, convolute organ; style long, slender, broadly rounded. Type Cecid. 1260.

Microcerata Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 309
1911 ———— N. Y. Ent. Soc. Jour., 19:32

This genus includes a number of small forms remarkable on account of the greatly reduced antennae. These organs in the male are composed of but 8 to 11 short segments, the second being greatly enlarged, subglobose and in general appearance much resembling those of the Campylomyzine genus Micromyia. The genitalia also differ from those of Lestremia. The one female known has very small antennae composed of 10 joints, the second being somewhat enlarged. This insect has been described as M. perplexa and appears to be closely related to M. diervillae and may possibly be the female of this species. Type Micromyia corni Felt.

Nothing is known concerning the life history and habits of members of this genus, though it is presumable that they are analogous to those of allied forms. It is very probable that the various species breed in decaying vegetable matter.

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Key to species

a Antennal segments 8
b Fourth palpal segment more than twice the length of the third; harpes broadly rounded apically.....johnsoni Felt, C. 802
bb Fourth palpal segment nearly twice the length of the third; harpes subacute apically.....cockerelli Felt, C. 932
aa Antennal segments 9
b Wings small, narrow, subcosta uniting with the margin before the basal half; palpi quadriarticulate.....corni Felt, C. 459
bb Wings rather large, broad, subcosta uniting with the margin at or beyond the basal half
c Scutellum dark brown, the legs a variable fuscous; palpi triarticulate, stout.....diervillae Felt, C. 490
cc Scutellum dark reddish brown, the legs a variable yellowish brown; palpi quadriarticulate, slender.....spinosa n. sp., C. 1295
aaa Antennal segments 10
b Length 1.5 mm, body dark brown; female....perplexa Felt
bb Length 1.25 mm, body dark brown; male....borealis n. sp., C. 1374
aaaa Antennal segments 11
b Scutellum yellowish brown; abdomen fuscous brown texana n. sp., C. 1294

Microcerata johnsoni Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 310

This form was taken August 2, 1891 by Prof. C. W. Johnson at Philadelphia, Pa.

Male. Length 1.75 mm. Antennae sparsely haired, pale yellowish; 8 segments, the fourth and following segments each somewhat more produced than the preceding, the sixth to the eighth with few or no subapical appendages. Palpi; the first segment, short, stout, subrectangular; the second a little longer, stouter, the third one-half longer than the second, more slender and the fourth more than twice the length of the third. Mesonotum dark brown, almost black. Scutellum, postscutellum and abdomen dark brown. Wings hyaline, costa reddish brown. Halteres yellowish basally, slightly fuscous apically. Legs a nearly uniform fuscous yellowish, tarsi slightly darker. Metatarsus more than two and one-half times as long as the following segment, the distal tarsal segment with a sparse subapical row of long, stout setae; claws rather long, stout, slightly curved, with a rather conspicuous tooth dorsally at the basal third and the concavity with several long, slender denticulations; pulvilli longer than the claws, thickly setose. Genitalia; basal clasp segment long, slender, terminal clasp segment swollen at the base, with several short, stout apical and subapical spines; dorsal plate broad, short, broadly and slightly emarginate; ventral plate apparently wanting. Harpes well separated, tapering, broadly rounded; style long, stout, tapering, broadly rounded. Type Cecid. 802.

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Microcerata cockerelli Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 310

This species, placed at our disposal through the courtesy of the United States National Museum, swarmed at Mesilla, N. M., in August and was collected by Prof. T. D. A. Cockerell.

Male. Length 1.75 mm. Antennae short, sparsely haired, dark brown; 8 segments, the fourth flattened basally and apically, with a length three-fourths its diameter, tapering, the other segments successively shorter, the terminal one fusiform, with a constriction

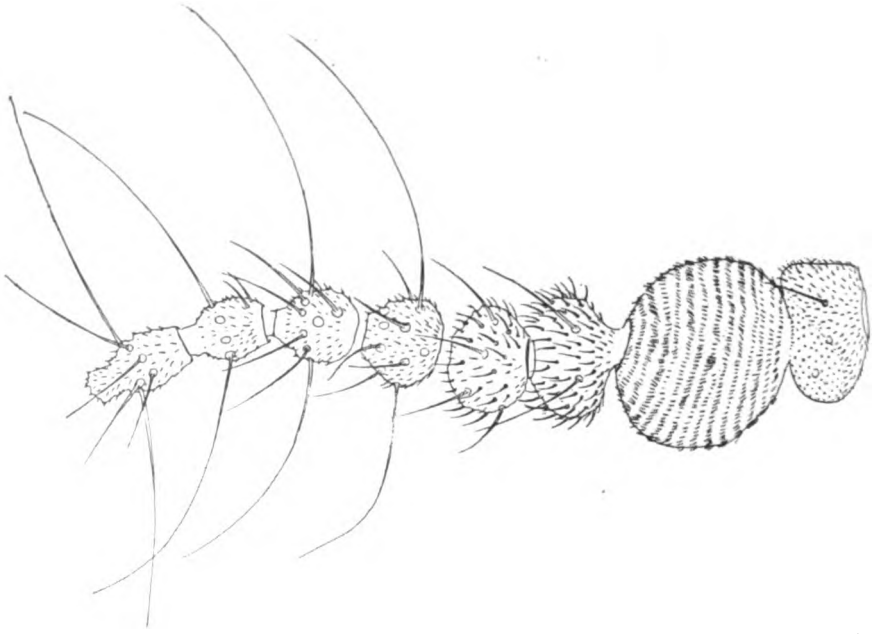


Fig. 23 Antenna of male Microcerata johnsoni, enlarged. (Original)

near the distal fourth. Palpi; the first segment stout, the second a little longer and more slender, the third one-half longer and more slender than the second and the fourth nearly twice the length of the third. Body dark brown. Wings hyaline, costa light brown. Legs light fuscous yellowish; claws stout, slightly curved, simple, the pulvilli as long as the claws. Genitalia; basal clasp segment long, slender, slightly curved, roundly truncate; terminal clasp segment long, tapering, the apex obtuse, spined; dorsal plate long, broad, broadly and roundly emarginate, the lobes divergent; ventral plate long, broad, tapering, irregularly rounded. Harpes long, slender, subacute; style long, slender, acute. Type Cecid. 932.

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Microcerata corni Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 102–3; separate, p. 6 (Micromyia)
1908 ———— N. Y. State Mus. Bul. 124, p. 310

This species was taken at Albany, N. Y., July 6, 1907 on Cornus.

Male. Length 1.5 mm. Antennae short, sparsely haired, dark brown; 9 segments, the fourth subglobose, with a length less than its diameter; terminal segment nearly three times the length of the preceding. Palpi; the first segment short, quadrate, the second as long as the first, slightly stouter, the third about as long as the second, more slender, the fourth nearly twice the length of the third. Mesonotum dark brown, the submedian lines with pale setae. Scutellum and abdomen dark brown, the latter nearly naked and with a distinct reddish tint distally. Wings hyaline, costa dark brown. Halteres pale orange basally, dark orange distally. Legs dark reddish, the tarsi dark brown; claws simple. Genitalia; basal clasp segment long, slender, obliquely truncate; terminal clasp segment stout, long, tapering, the apex spined; dorsal plate apparently simple, broad, tapering, narrowly rounded; ventral plate apparently similar. Harpes broad, stout, narrowly rounded; style long, slender. Type Cecid. 459.

Microcerata diervillae Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 103; separate, p. 6–7 (Micromyia)
1908 ———— N. Y. State Mus. Bul. 124, p. 310

This species was taken at Karner, N. Y., June 5, 1907 on bush honeysuckle, Diervilla trifida.

Male. Length 1.5 mm. Antennae short, sparsely haired, dark brown; 9 segments, the third pyriform, the fourth with a very short stem; terminal segment produced, nearly twice the length of the preceding, pyriform. Palpi; the first segment stout, with a length twice its diameter, the second narrowly oval, a little shorter, the third one-half longer than the second, more slender. Mesonotum dark brown. Scutellum, postscutellum and abdomen dark brown, the latter slightly yellowish distally. Wings hyaline, costa light brown. Halteres fuscous yellowish. Legs a variable fuscous, the posterior tarsi tinged with carmine; claws simple, the pulvilli longer than the claws. Genitalia; basal clasp segment long; terminal clasp segment short, stout, the apex recurved; dorsal plate broadly rounded; ventral plate broad, incised, the lobes narrowly rounded. Harpes long, stout, tapering; style long, slender, narrowly rounded. Type Cecid. 490.

Microcerata spinosa n. sp.

This species was taken at dark in an oat field at Plano, Texas, in May 1907 by Mr E. S. Tucker.

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Male. Length .75 mm. Antennae as long as the head, composed of 9 segments, the fifth pyriform; terminal segment somewhat produced, fusiform, with a length about twice its diameter. Palpi long, the first and second segments subequal, subrectangular, the third one-half longer, more slender and the fourth twice the length of the third; eyes large, black. Mesonotum dull dark brown.

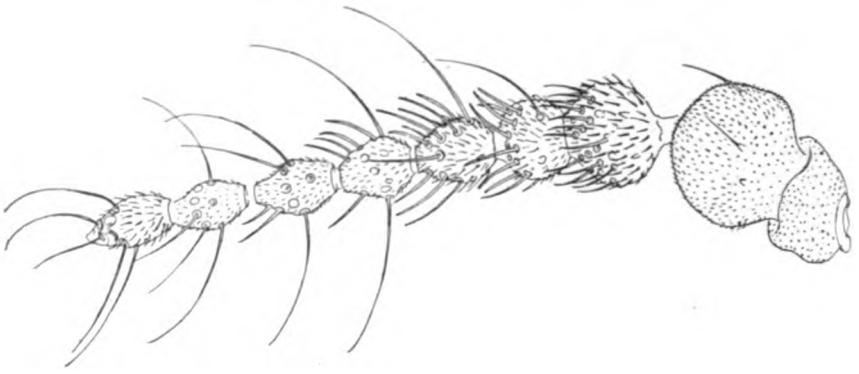


Fig. 24 Antenna of Microcerata spinosa, enlarged. (Original)

Scutellum dark reddish brown, postscutellum a little darker. Abdomen dull dark brown, the genitalia fuscous yellowish. Wings rather large, hyaline, costa yellowish brown. Halteres yellowish transparent. Legs a variable yellowish brown, the tarsi a little darker; claws simple, pulvilli large. Genitalia; basal clasp segment long, slender, tapering distally; terminal clasp segment rather long, swollen basally and tapering slightly to an obtuse, curved, thickly haired apex; dorsal plate tapering, broadly rounded and thickly setose apically; ventral plate tapering to a narrowly rounded apex; style long, slender, acute distally. Type Cecid. 1295.

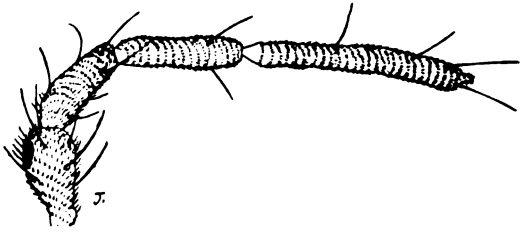


Fig. 25 Palpus of Microcerata spinosa, enlarged. (Original)

Microcerata perplexa Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 310

The female representing this species was taken on the office window July 19, 1907, and was presumably reared from some material in the office.

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Female. Length 1.5 mm. Antennae short, sparsely haired, dark brown, 10 segments, the fourth with a length about three-fourths its diameter, greatly dilated near the basal third and roundly tapering to the broad apex; terminal segment produced, strongly constricted near the distal third and broadly rounded. Palpi; the first segment long, expanded distally and with a conspicuous sense organ on the internal distal third, second segment nearly as long as the first, more slender, the third one-half longer and more slender than the second, the fourth one-half longer and more slender than the third. Entire body nearly uniform dark brown. Wings hyaline, costa dark brown. Halteres presumably fuscous. Legs presumably a fuscous brown; claws simple, the pulvilli a little shorter than the claws. Ovipositor short, the terminal lobes indistinctly triarticulate, the basal segment indistinct, the second broadly rounded, the third irregularly oval. Type Cecid. 1375.

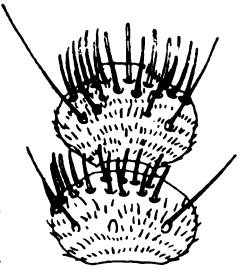


Fig 26. Fourth and fifth antennal segments of Microcerata perplexa, enlarged. (Original)

Microcerata borealis n. sp.

This species was taken by Mr D. B. Young at Speculator, N. Y., July 27, 1909.

Male. Length 1.25 mm. Antennae extending to the base of the anterior coxae, sparsely haired, dark brown; 10 segments, the fifth subglobose, slightly pyriform, with a length slightly greater than its diameter. Terminal segment subcylindric, with a length two and one-half times its diameter. Palpi; the first segment stout, rectangular, with a length twice its diameter, the second a little longer, swollen distally, the third a little shorter than the second, narrowly triangular, the fourth one-half longer than the second, irregular, compressed. Thorax and abdomen a nearly uniform dark brown. Wings hyaline, costa light brown. Halteres yellowish brown; coxae dark brown; femora, tibiae and tarsi a dark yellowish brown; claws long, evenly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment long, tapering; terminal clasp segment rather stout, recurved apically; dorsal plate long, tapering, narrowly rounded; ventral plate divided, the lobes divergent, roundly truncate and thickly setose; style long, slender. Type Cecid. 1374.

Microcerata texana n. sp.

This species was taken at Plano, Texas, July 1907 by Mr E. S. Tucker.

Male. Length 1.25 mm. Antennae hardly extending to the base of the abdomen, thickly haired, fuscous brown, composed of 11

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segments, the fifth pyriform; the stem one-fourth the length of the enlargement, the tenth and eleventh segments fused though separated by a distinct stem. Palpi probably quadriarticulate, stout, the first segment subrectangular, slightly swollen distally, the second a little longer, rather stout, the third probably longer than the second, more slender. Mesonotum dark brown, the submedian lines sparsely haired and irregularly tuberculate. Scutellum yellowish brown, postscutellum and abdomen fuscous brown, genitalia dark fuscous yellowish. Wings hyaline, costa yellowish brown. Halteres yellowish transparent, legs a variable yellowish or yellowish brown, the distal tarsal segments somewhat darker; claws probably simple. Genitalia; basal clasp segment rather stout, with a distinct lobe basally and tapering to a subtruncate apex; terminal clasp segment rather stout at base and tapering to a subacute, thickly setose apex; dorsal plate rather long, broad, broadly rounded and thickly setose apically; ventral plate long, slender, subtruncate distally; style long, slender, acute apically. Type Cecid. 1294.

Tritozyga H. Lw.

1862 **Loew, H.** Monog. Dipt. N. Amer., 1:177, 178–79
1876 **Bergenstamm, J. E., & Löw, Paul.** Syn. Cecidomyidarum, p. 18
1888 **Skuse, F. A. A.** Linn. Soc. N. S. Wales Proc., 3:44, 143
1897 **Kieffer, J. J.** Syn. Cecid. Eur. & Alg., p. 53
1900 ———— Soc. Ent. Fr. Ann., 69:447–48
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:32

This peculiar North American form was made the type of a new genus by H. Loew, who refrained from bestowing a specific name because of the mutilated condition of the specimen. Through the courtesy of Mr Samuel Henshaw it has been possible to study the type, now in the Museum of Comparative Zoology at Cambridge, Mass. This species is more closely related to the author's Microcerata than to any other known genus. It is easily separated from Microcerata by the uneven fork of the fourth vein, the posterior branch being a nearly straight continuation, while the anterior branch arises at nearly a right angle and describes a broadly S-shaped curve before uniting with the margin. This character alone suffices to distinguish it from all other Itonididae. The fourth, fifth and sixth veins are distinctly heavier than in Microcerata, the last having a somewhat sinuous course. The antennae are composed of but 9 segments, the second being somewhat enlarged and the terminal segment, evidently composed of 3 rather closely fused, distinctly produced and with a length fully six times its diameter. The palpi are plainly stouter than in Microcerata.

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Tritozyga sackeni Felt

1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:32

This unique form represents a valid species, and though mutilated it seems preferable to bestow a specific name and publish the characters so far as they can be determined, particularly as this procedure fixes the identity of the genus beyond all question and removes the danger of another synonym being added to an already overburdened nomenclature.

Male. Eyes black; occiput brown. Antennae short, with 9 segments, the basal ones pale yellowish, the distal brown; first segment small, subglobose, the second distinctly enlarged, ovate, the third subcylindric, with a length three-fourths its diameter, the fourth with a length a little greater than its diameter, the fifth about the same length as the fourth, with a scattering subbasal whorl of rather short, curved setae; subapically, on the posterior face there is an irregular group of oval, tuberculate elevations, possibly a special sense organ. Terminal segment evidently composed of three closely fused segments, with a length fully six times its diameter and whorls of stout setae similar to the subbasal one above described near the basal fourth, the middle and the distal fourth of this compound segment. Palpi yellowish, probably quadriarticulate, the first probably with a length one-half greater than its diameter, the second short, the penultimate cylindric, with a length about four times its diameter, the terminal as long as the preceding, slightly dilated apically and with a few coarse setae; three small ocelli. Mesonotum dark brown. Scutellum yellowish, sparsely setose. Wings hyaline, length 1.5 mm; costa dark brown, rather densely haired; subcosta uniting with the anterior margin near the basal third, the third vein apparently united with subcosta near the basal fourth and joining the anterior margin near the distal third; both this and subcosta heavy, dark brown and sparsely haired. The fourth vein rather distinct, slightly curved, its posterior branch an almost direct continuation of the basal portion, while the anterior branch arises at a nearly right angle, and after describing a broadly S-shaped curve, unites with the anterior margin near the distal fifth; fifth vein nearly straight, joining the posterior margin at the distal fourth, the sixth vein stout, irregularly curved and uniting with the posterior margin near the basal half. Halteres probably yellowish, the stem long, curved, the distal portion spatulate. Coxae yellowish; femora, tibiae and tarsi yellowish brown, the latter with five segments, the first longer than the second, the claws probably simple. Type in the Museum of Comparative Zoology.

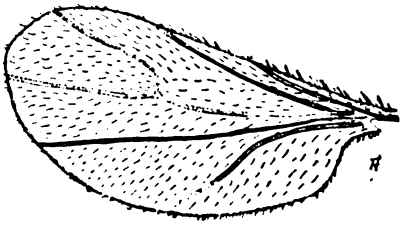


Fig. 27 Wing of Tritozyga sackeni, enlarged. (Original)

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Neptunimyia Felt

1912 **Felt, E. P.** N. Y. Ent. Soc. Jour., 20:237

This genus represents a unique form intermediate in development between Lestremia and the highly reduced antennal structures of Microcerata and Tritozyga. It is more closely allied to the former though easily separated therefrom by the normal second antennal segment, the digitate antennal appendages and the stoutly pectinate claws. The type species is N. tridens n. sp.

Neptunimyia tridens Felt

1912 **Felt, E. P.** N. Y. Ent. Soc. Jour., 20:237–38

This most interesting female was reared April 17, 1911, from a jar containing maple leaves infested last year with the larva of Cecidomyia ocellaris O.S. It is possible that the

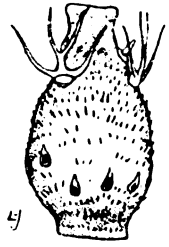


Fig. 28 Fifth antennal segment of Neptunimyia tridens, enlarged. (Original)

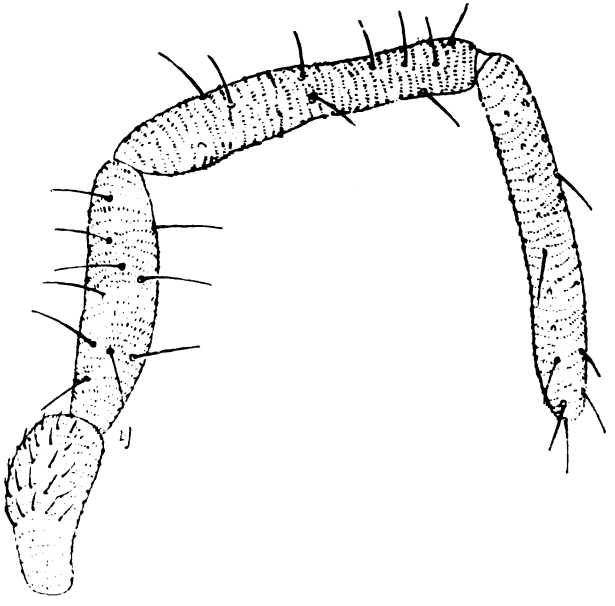


Fig. 29 Palpus of Neptunimyia tridens, enlarged. (Original)

insect developed from the very slight amount of decaying organic matter brought in with the sand. We are unwilling to believe that it is the parent insect of the semitransparent larvae producing in midsummer the numerous ocellate galls on soft maple leaves. Paridris nigricornis Brues was reared from this jar and may be a parasite of C. ocellaris O.S.

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Neocatocha Felt

1912 **Felt, E. P.** N. Y. Ent. Soc. Jour., 20:236

This remarkable form has the venation of Catocha and the greatly reduced antennae of Microcerata, from which latter it is easily distinguished by the normal second antennal segment. The short, sessile, flagellate antennal segments and the characteristic venation serve to separate this genus from Neptunimyia. Type N. marilandica.

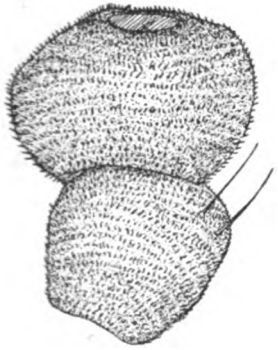


Fig. 30 First two antennal segments of Neocatocha marilandica, enlarged. (Original)



Fig. 31 Two flagellate antennal segments of Neocatocha marilandica, enlarged. (Original.)

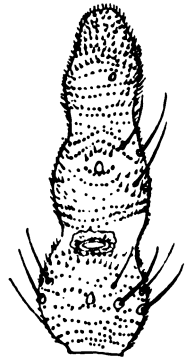


Fig. 32 Distal antennal segment of Neocatocha marilandica, enlarged. (Original)

Neocatocha marilandica Felt

1912 **Felt, E. P.** N. Y. Ent. Soc. Jour., 20:236–37

One female was taken by Dr W. L. McAtee on Plummers island, Maryland, March 24, 1907.

Female. Length 1.75 mm. Antennae short, dark brown; 8 segments, the first and second normal, the fifth sessile, subglobose, with a length slightly greater than its diameter, irregularly and sparsely clothed with short setae and subapically with a whorl of probably four short, stout, fleshy appendages; terminal segment compound, composed of three closely fused, and with a length about four times its greatest diameter. Palpi; first segment irregularly quadrate, the second and third subequal, each with a length 2 and one-half times the diameter, the fourth a little longer, more slender. Eyes moderate, black, coarsely granulate; ocelli present. Mesonotum dark reddish brown. Scutellum yellowish brown, postscutellum slightly darker. Abdomen mostly dark yellowish brown. Wings hyaline.

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Halteres yellowish brown. Legs mostly dark yellowish brown; claws moderately stout, strongly curved, simple, the pulvilli as long as the claws. Ovipositor short, the lobes triarticulate, the distal segment suborbicular. Ventrally, on the ninth segment, there is a pair of submedian, fuscous, pyriform appendages. Type C. 1390.

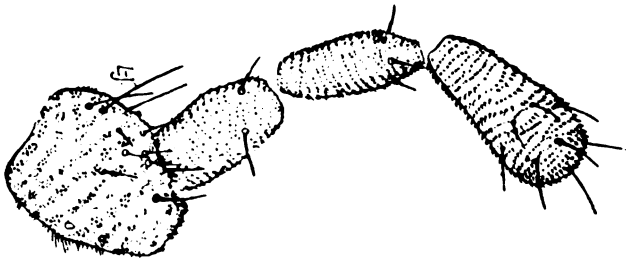


Fig. 33 Palpus of Neocatocha marilandica, enlarged. (Original)

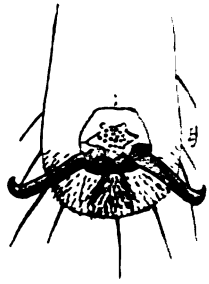


Fig 34 Claws o Neocatocha ma rilandica. en larged. (Original)

Neocatocha spinosa n. sp.

This remarkable female was found in the National Museum collection labeled "with specimens sent by A. R. Barber, December 16, 1873."

Female. Length 2 mm. Antennae extending nearly to the base of the abdomen, sparsely haired, yellowish brown; 10 segments, the fifth with a short stem one-fourth the length of the oval basal enlargement, which latter has a length fully one-half greater than its diameter, a sparse basal whorl of long, stout setae and subapically a partial whorl of thickly set, short, stout, curved spines; terminal segment reduced, with a length one-half greater than its diameter, narrowly rounded apically. Palpi; first segment short, subquadrate, the second with a length twice its diameter, the third a little longer than the second, the fourth one-half longer than the third, dilated apically. Ocelli present. Thorax dark brown. Abdomen yellowish brown, the terminal segments dark brown. Ovipositor short, triarticulate, the distal segment narrowly oval, thickly setose. Wings hyaline, irridescent. Halteres and legs yellowish brown, the distal tarsal segments darker. Claws stout, evenly curved, simple, the pulvilli about one-third the length of the claws. Type Cecid. 1415.

Lithomyza Scudd.

1877 **Scudder, S. H.** U. S. Geol. Geog. Surv. Terr. Bul. 3, p. 746
1890 ———— Tert. Ins. N. Amer., U. S. Geol. Geog. Surv. Terr. Rep't, v. 13, p. 600–01
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:32

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This genus was erected by Scudder for a single specimen found in the Chagrin Valley, White River, Colorado. It is evidently closely allied to Lestremia. The illustration of the wing shows that subcosta unites with the margin near the basal third. The first branch of media, which in Lestremia has disappeared, joins costa a little beyond the middle. The second branch of media joins the margin a little before the apex and is united to subcosta by a short, well-defined crossvein, evidently the vein present throughout the Lestremiinariae, Campylomyzariae and Epidosariae. The third and fourth branches of media which, for convenience sake we have designated in this work the fourth vein, is forked as in Lestremia; the fifth and sixth veins are free. The short nine-jointed antennae indicate a close affinity with Tritozyga O.S. and Microcerata Felt. Type Lithomyza condita Scudd.

This genus, if correctly placed, is the most generalized Cecidomyiid known and must be regarded as a connecting link between this group and the Mycetophilidae.

CAMPYLOMYZARIAE

This tribe is easily separated from the Lestremiinariae by the simple, nearly obsolescent fourth vein.

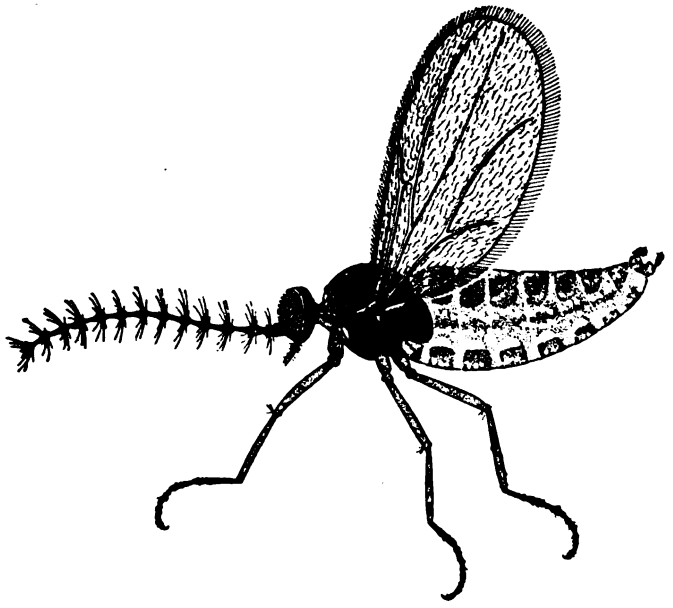


Fig. 35 Cordylomyia coloradensis, enlarged. (Original)

The typical genus, Campylomyza Meign., was erected in 1818, four species, C. flavipes, C. bicolor. C. atra and C.

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aceris being named. Kieffer in 1896, holding that the genus as characterized by Meigen comprised a group, designated C. munda Winn. as the type. An examination by the writer, of specimens in Meigen's collection deposited in the Natural History Museum of Paris, representing the four species originally assigned to this genus, showed that the specimens are in such poor condition that they can hardly be used to advantage in establishing the identity of the generic type. The form designated by Kieffer as the type of the genus, namely, C. munda Winn., unfortunately has not been characterized with sufficient fulness so that it can be separated from allied forms. Under the conditions, we are compelled for the present to treat Campylomyza Meign. as a supergenus, referring thereto forms which can not be readily assigned to some of the more recent genera. Owing to the paucity of our reared material in this group, we have been unable to make a critical study of the generic characters, though the little data we have obtained in this manner would seem to justify the existence of the recently established genera.

Key to genera

a Wingless, or if wings are present, the fifth vein simple
b Claws with long, parallel teeth, the pulvilli very short..... Strobliella Kieff.
bb Claws denticulate, the puvilli absent .....Wasmanniella Kieff.
aa Winged, fifth vein forked
b Third vein usually well separated from costa and frequently uniting therewith at or beyond the apex
c Flagellate antennal segments globose, stemmed in both sexes and ornamented only with whorls of long hairs
d Fourth vein present
e Palpi tri- or quadriarticulate
f Wings normal, slender, antennal segments, male 14, female 11. Joannisia Kieff.
ff Wings broad, not twice as long as wide, antennal segments, female 12 .....Projoannisia Kieff.
ee Palpi biarticulate, the male with 14 and the female with 13 antennal segments, the claws strongly bent, dilated subapically.....Peromyia Kieff.
dd Fourth vein wanting
e Antennal segments stemmed.....Trichopteromyia Will.
ee Antennal segments sessile, the second enlarged, globose; palpi triarticulate.....Ceratomyia Felt
cc Flagellate antennal segments cylindric, subsessile; male with 12, female with 9 antennal segments; fourth vein rudimentary, obsolete distally.....Mycophila Felt

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bb Third vein rarely extending to the apex of the wing; flagellate antennal segments subsessile in the female, ornamented with crenulate whorls or other structures more complex than irregular whorls of simple hairs

c Antennae very short, the male with 10 to 11, the female with 6 to 8 subsessile segments, the second greatly enlarged..... Micromyia Rond.

cc Antennae not very short, the male with 14, the female with 11 to 22 antennal segments, the second not greatly enlarged..... Campylomyza Meign.[1]

d Flagellate antennal segments with a more or less distinct collar subapically

e Claws denticulate, the pulvilli well developed..Prionellus Kieff.

ee Claws simple, the pulvilli short or rudimentary..Aprionus Kieff.

dd Flagellate antennal segments with a subapical whorl of stemmed disks; claws with a minute subapical tooth....Monardia Kieff.

ddd Flagellate antennal segments with reniform processes subapically, claws bent at right angles, dilated subapically..... Bryomyia Kieff.

dddd Flagellate antennal segments with subapical whorls of short, stout, usually recurved spines.....Cordylomyia Felt

ddddd Flagellate antennal segments with series of whorls of short, stout, curved spines.....Corinthomyia Felt

Strobliella Kieff.

1897 **Kieffer, J. J.** Syn. Cecid. Eur. & Alg., p. 51
1900 ———— Soc. Ent. Fr. Ann., v. 69, pl. 22, fig. 9
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:32

This genus, as characterized by Kieffer, has five simple long veins, the anterior border of the wing not being interrupted and passing gradually into the posterior margin. The palpi are quadriarticulate and the tarsal claws are provided at the basal half with long, parallel teeth; the pulvilli are very short. The illustration of the wing shows that this genus is closely allied to Campylomyza, the third vein uniting with costa at the apex, the fifth and sixth veins being simple; subcosta joins the anterior margin near the basal half, while the crossvein appears unusually long. Type S. intermedia Kieff.

Wasmanniella Kieff.

1897 **Kieffer, J. J.** Syn. Cecid. Eur. & Alg., p. 49
1900 ———— Soc. Ent. Fr. Ann., v. 69, pl. 17, fig. 11, 12
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:32

Members of this genus, according to Kieffer, may be recognized by the denticulate claws, the absence of pulvilli and by the subglobose, stemmed antennal segments. Each of the flagellate segments

[1] Owing to the unsatisfactory characterization of Campylomyza Meign., it is tentatively given rank as a supergenus. See above.

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has a whorl of hairs and a subapical whorl of 4 hyaline, hooked appendages. The female is remarkable on account of the absence of wings. The larvae live under the leaf sheath of Scirpus silvaticus. It was impossible, from a study of the type kindly placed at my disposal by Professor Kieffer, to add to the above Type and sole species W. aptera Kieff.

Joannisia Kieff.

1894 **Kieffer, J. J.** Soc. Ent. Fr. Bul., p. 175
1896 ———— Mis. Ent., 4:7
1897 ———— Syn. Cecid. Eur. & Alg., p. 48
1904 **Meunier, F.** Soc. Sci. Brux. Ann., 28:9
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 312
1909 ———— Ent. Soc. Cent. 39th Rep't, p. 44
1911 ———— N. Y. Ent. Soc. Jour., 19:32

The antennae have 11 segments in the female and 14 in the male Joannisia, the flagellate segments with a subglobular enlargement ornamented only with irregular whorls of simple setae and a smooth, cylindric stem distally (figure 36). The venation is

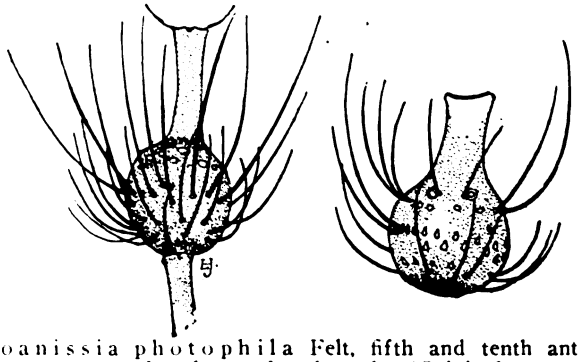


Fig. 36 Joanissia photophila Felt, fifth and tenth antennal segments of male, much enlarged. (Original)

very characteristic, since the third vein is well separated from costa, runs nearly parallel thereto and unites with the margin at or well beyond the apex; the fourth vein is simple, the fifth forked. The terminal clasp segment of the male is slender, curving and tapering to an acute apex in all species known to us, except in J. neomexicana.

One American species, J. pennsylvanica Felt, received through the courtesy of Prof. H. A. Surface, has been reared by Mr B. H. Farr of Reading, Pa., from decaying peony roots. Aside from this, nothing is known concerning the life history of our native forms. Kieffer has reared several European species from

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decaying wood, from tufts of moss and also from a mold covering a fungus. It is very probable that our American species live under similar conditions, particularly as they are most numerous in the vicinity of forests or where there is an abundance of decaying vegetable matter. The generic type is J. aurantiaca Kieff.

Key to species

a 11 antennal segments, females
b Abdomen dark brown, unicolorous, palpi triarticulate..... flavopedalis Felt, C. 687
bb Abdomen dark reddish brown, fuscous distally, palpi quadriarticulate.....carolinae Felt, C. a1619
aa 14 antennal segments, males
b Terminal clasp segment slender, tapering to an acute point
c Legs thickly haired
d Postscutellum reddish brown.....
e Terminal antennal segment reduced, oval..... photophila Felt, C. 747, 748, 753, 472
ee Terminal antennal segment produced, with a knob apically ... pennsylvanica Felt, Cecid. a1928
dd Postscutellum fuscous yellowish.....flavoscuta Felt, C. 653
cc Legs sparsely haired.....carolinae Felt, C. a1619
bb Terminal clasp segment stout, broadly rounded apically
c Mesonotum dark brown, scutellum and abdomen a little lighter.... neomexicana n. sp., C. 891

Joannisia flavopedalis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 313

This female was taken at Newport, N. Y., July 25, 1906.

Female. Length .5 mm. Antennae probably nearly as long as the body, sparsely haired, dark brown, 11 segments; fifth subglobose; terminal segment with the basal portion slightly produced, narrowly oval. Palpi; the first segment somewhat enlarged, subglobose, the second rather slender, one-half longer, the third somewhat irregular, nearly twice the length of the second. Eyes rather small, black; ocelli present. Head, thorax and abdomen apparently a nearly uniform dark brown, ovipositor pale yellowish. Wings hyaline, costa dark brown, subcosta joining the margin just before the basal half. Legs pale yellowish, the articulations variably tinged with dark carmine; distal tarsal segments reddish brown; metatarsus a little longer than the following segment; claws very long, slender, strongly curved, simple; pulvilli nearly as long. Ovipositor short, the terminal lobes triarticulate, the basal subquadrate, the second a little longer, dilated distally, the third narrowly oval, all sparsely setose; minor lobe long, slender, narrowly rounded. Type Cecid. 687.

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Joannisia carolinae Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 100; separate, p. 4 (Campylomyza)
1908 ———— N. Y. State Mus. Bul. 124, p. 313

This species was taken on a window in a woodland hut at Davidson's River N. C., September 23, 1906.

Male. Length .4 mm. Antennae twice the length of the body, light brown; 14 segments, the fifth with a stem one-fourth longer than the subglobose enlargement; terminal segment suboval. Palpi: the first segment very broad, short, second broadly oval, the third narrowly oval and the fourth smaller. Mesonotum reddish brown. Scutellum, postscutellum and basal abdominal segments dark reddish brown, distal abdominal segments dull black. Wings hyaline, costa dark brown, subcosta uniting with the margin at the basal half; halteres yellowish basally, fuscous apically. Legs nearly uniform fuscous yellowish, sparsely haired, posterior metatarsus slender, more than twice the length of the following segment; claws strongly curved, almost at right angles, simple; pulvilli slender, nearly as long as the claws. Genitalia; basal clasp segment stout, broad, truncate, with an internal chitinous spine; terminal clasp segment broad at base, tapering. Dorsal plate rather broad, evenly rounded.

Female. Length .5 mm. Antennae a little longer than the body, light brown; 11 segments, the fifth with a stem two-thirds the length of the globular basal enlargement; terminal segment suboval. Palpi: the basal segment large, suboval, the others regularly decreasing in size. The colorational and structural characters of the thorax and its appendages practically as in the male. Ovipositor short, terminal lobes biarticulate, the basal subquadrate, the distal suboval. Type Cecid. a1619.

Joannisia photophila Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 99; separate, p. 3 (Campylomyza)
1908 ———— N. Y. State Mus. Bul. 124, p. 313

This species is evidently one of our most common forms as it was taken on the office window at Albany during July and August, and also captured in a trap lantern at Poughkeepsie August 7, 1906.

Male. Length .5 mm. Antennae nearly as long as the body, thickly haired, dark brown; 14 segments, the fifth with a stem one-fourth longer than the globose enlargement, terminal segment ovate, thickly and irregularly clothed with long hairs. Palpi; the first segment quadrate, about one-half longer than broad, the second irregularly oval, broad, the third narrowly oval, as long as the

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second, the fourth one-half the length of the preceding, oval. Mesonotum dark reddish, submedian lines indistinct. Scutellum and postscutellum reddish brown. Abdomen dark brown, somewhat fuscous posteriorly. Wings hyaline, costa dark brown, halteres dark reddish. Legs fuscous yellowish, distal tarsal segments reddish brown; claws medium, strongly curved, simple; pulvilli nearly as long as the claws. Genitalia; basal clasp segments stout, broad, truncate and apparently with a large, curved, chitinous process extending behind the median plates and nearly touching a similar process arising from the opposite segment; terminal clasp segment swollen basally. Dorsal plate smooth, broadly rounded, short, ventral plate similar. Type Cecid. 747.

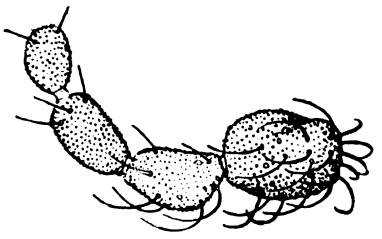


Fig. 37 Palpus of Joannisia photophila, enlarged. (Original)

Joannisia pennsylvanica Felt

1911 **Felt, E. P.** Econ. Ent. Jour., 4:476

This species was submitted for study by Prof. H. A. Surface, who states that it was reared from decaying peony roots by Mr B. H. Farr of Reading, Pa.

Joannisia flavoscuta Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 313

This form was taken on a window at Nassau, N. Y., July 24, 1906.

Male. Length .5 mm. Antennae a little longer than the body, thickly haired, dark brown; 14 segments, 5th with stem one-fourth longer than the globose enlargement; terminal segment suboval. Palpi; the first segment broadly oval, the second nearly as long, narrowly oval, the third a little shorter, more slender, the fourth shorter and more slender. Mesonotum dark brown, submedian lines indistinct. Scutellum reddish brown, postscutellum dark fuscous yellowish. Abdomen nearly uniform dark brown. Wings hyaline, costa dark brown. Halteres yellowish transparent basally, fuscous apically. Legs mostly a fuscous yellowish, tarsi variably tinged with carmine; claws long, slender, strongly curved near the middle, simple. Genitalia; basal clasp segment short, stout, with a conspicuous chitinous tooth internally, obliquely truncate; terminal clasp segment short, stout, greatly swollen at the base. Dorsal plate short, broadly rounded, ventral plate a little wider, longer, broadly rounded. Type Cecid. 653.

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Joannisia neomexicana n. sp.

This species was taken at Pecos, N. M., August 25th, by Prof. T. D. A. Cockerell.

Male. Length .75 mm. Antennae brown, about twice the length of the body, thickly haired; 14 segments, the fifth with a stem one-fourth longer than the globose enlargement; terminal segment dumbell-shaped, the basal swelling somewhat greater than the distal one, the two broadly united. Palpi apparently missing. Mesonotum dark brown. Scutellum and abdomen a little lighter. Wings hyaline, costa light brown. Legs a variable yellowish, the distal tarsal segments slightly fuscous; claws long, slender, strongly curved, minutely denticulate, the pulvilli as long as the claws. Genitalia: basal clasp segment stout, truncate; terminal clasp segment short, stout, slightly swollen near the middle. Type Cecid. 891.

Projoannisia Kieff.

1912 **Kieffer, J. J.** Neue Gallm.-Gatt. p. 2

This form is allied to Joannisia, has unusually broad wings and the third vein is nearer the rudimentary fourth than to costa. The antennal segments are 12, subsessile, the stem being about one-fourth the length of the pyriform basal enlargement, the latter with subapical, heavy, curved special sense organs not appearing in typical Joannisia. The simple claws are only slightly bent and about twice the length of the pulvilli. The ovipositor is very short. Type Joannisia latipennis Kieff.

Peromyia Kieff.

1894 **Kieffer, J. J.** Soc. Ent. Fr. Bul., p. 175
1896 ———— Mis. Ent., 4:7, 11
1897 ———— Syn. Cecid. Eur. & Alg., p. 48
1900 ———— Soc. Ent. Fr. Ann., v. 69, pl. 22, fig. 12; pl. 24, fig. 1, 2
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:32

The antennal segments in this genus are subglobose, the segments (male 14, female 13) with long stems in both sexes. The palpi are biarticulate. The claws are bent at almost right angles and greatly swollen at the distal third. The anterior border of the wing extends a little beyond the third vein. The pulvilli are long. The third vein curves distally and joins the margin near the rudimentary fourth vein. The basal clasp segment of the male is stout, truncate, the terminal clasp segment short, stout, curved subapically, greatly swollen and obtusely rounded distally. Ovipositor quadriarticulate. Through the courtesy of the authorities we were allowed to study the excellent microscopic preparations of this genus in the Berlin Natural History Museum.

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Neurolyga Rond., 1846, appears to be close to Peromyia Kieff, and the latter may prove to be identical therewith.

The pupa of the typical species is somewhat remarkable on account of its slender form and especially because of the 3 lateral triangular appendages arising from the first to third segments. The ventral abdominal surface is thickly studded with chitinous points, while the dorsum is ornamented with short, stout, chitinous spines. Type P. leveillei Kieff. No American forms have been recognized.

Trichopteromyia Will.

1896 **Williston, S. W.** Ent. Soc. London Trans., p. 255
1901 **Kieffer, J. J.** Suite Syn. Cecid. Eur. & Alg., p. 16–17
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:33

This West Indian genus is evidently allied to Campylomyza Meign. and may be distinguished therefrom, as indicated by the describer's illustration of the wing, by the absence of the rudimentary fourth vein; subcosta unites with the margin at the basal third, the third vein at the apex and the fifth just beyond the basal half, its branch near the basal third. The female antenna, as illustrated, presents much the same form as that of Joannisia with which this genus may be closely allied. Type T. modesta Will.

Mycophila Felt

1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:33

This genus is evidently related to Joannisia Kieff., though readily separable therefrom by the small number of antennal segments and by the rudimentary fourth vein being obsolete distally. Type M. fungicola Felt.

Mycophila fungicola Felt

1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:33

This species was reared from young mushrooms collected by H. Cecil Evans at San Rafael, Cal., September 7, 1897. Mr Pergande, of the Bureau of Entomology, Washington, D. C., states that the flies are red, the abdomen paler, marked with narrow, pale dusky bands, the thorax is dusky or blackish above, eyes black. Antennae and legs pale dusky and with a yellowish tinge.

Larvae. Length .75 mm., rather stout, broadly rounded posteriorly, nearly so anteriorly, pale orange. Head subrectangular with a diameter about one-half that of the body, antennae apparently uniarticulate, rather long, stout, with a length about five times the

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diameter, at the distal fifth tapering suddenly to an acute apex. No breast bone is apparent, the surface of the body is smooth.

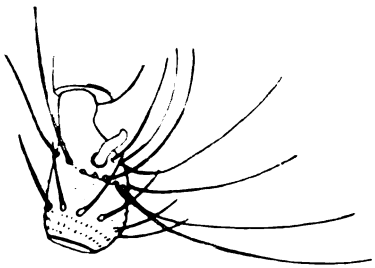


Fig. 38 Fifth antennal segment of male of Mycophila fungicola, enlarged. (Original)

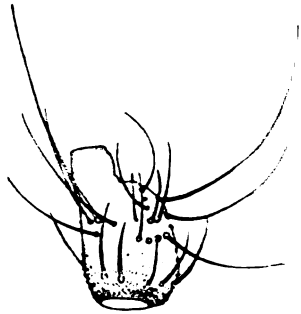


Fig. 39 Fifth antennal segment of male of Mycophila fungicola, other side, enlarged. (Original)

Female. Length .6 mm. Antennae extending to the second abdominal segment, sparsely haired, fuscous yellowish; 9 segments, the first broadly obconic, the second subglobose, the third produced, fusiform, free, the fifth with a length about twice its diameter, subcylindric, tapering; subbasal whorl of setae thick, long, curved; subapical band finer; distally there are apparently four broad, chitinous lobes; terminal segment produced, the basal portion broadly oval, the distal smaller, almost subglobose. Palpi indistinct. Ovipositor short, biarticulate, the basal sclerite long, broad, quadrate, tapering distally, the terminal sclerite broadly oval, both sparsely setose, minor lobe long, obliquely truncate, sparsely setose. Other characters as in the male, see citation.

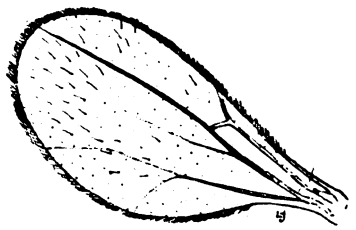


Fig. 40 Wing of Mycophila fungicola, enlarged. (Original)

Ceratomyia Felt

1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:33

Allied to Micromyia Rond. on account of the greatly enlarged second antennal segment, though easily separated therefrom by the absence of the fourth vein. The latter character indicates a relationship with Trichopteromyia Will. from which it may be separated by the greatly reduced antennal segments with only 6 short, sessile segments.

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Ceratomyia johannseni Felt

1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:33-4

This interesting species was received from Ocotlan, Mexico, through Dr O. A. Johannsen under date of December 12, 1910. See above citation for a detailed description.

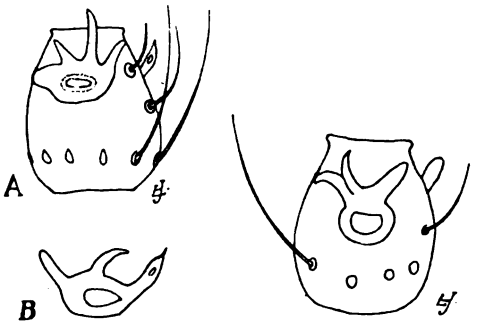


Fig. 41 Fifth antennal segment of female Mycophila fungicola; *b*, tridigitate process; *c*, fifth segment from other antennae, enlarged. (Original)

Micromyia Rond.

1840 **Rondani, Camillo.** Memoira II a per serv. alla Ditterolog. Ital. Parma, 23
1846 ———— Nouv. Ann. Sc. nat. Bologna, ser. 2, p. 369, 373
1864 **Schiner, J. R.** Fauna Austriaca Dipt., p. 411-12
1870 **Winnertz, J.** Vehr. z.-b.-Ges. Wien, 20:27
1876 **Bergenstamm, J. E. & Löw, Paul.** Syn. Cecidomyidarum, p. 18
1892 **Theobald, F. V.** Acct. Brit. Flies, p. 86
1896 **Kieffer, J. J.** Misc. Entomol., 4:24
1897 ———— Syn. Cecid. Eur. & Alg., p. 50
1900 ———— Soc. Ent. Fr. Ann., 69:441
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:34

This genus was erected by Rondani in 1840 for certain small forms presenting the general appearance of Campylomyza and easily distinguished therefrom by the 10 or 11 antennal segments of the male and the 8 of the female, they being sessile in both sexes; the second greatly enlarged, and having a diameter more than twice that of the third. The antennal setae of the male are unusually long, being three to four times as long as the segment. The palpi are quadriarticulate, the first segment rudimentary, the others nearly normal, the third in the female greatly expanded apically. Subcosta joins the anterior margin near the middle, the third vein before the apex and is united to subcosta by a distinct cross vein; the fourth vein is simple, indistinct and joins the posterior margin; the fifth

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at the distal third, its branch at the basal third. Terminal clasp segment long, stout, rounded apically.

The above is based on previous accounts and a study of specimens identified by Winnertz in the British Museum of Natural History and a good series in the Winnertz collection at the University of Bonn. Type M. lucorum Rond. No American species are known.

Campylomyza Meign.

1818 **Meigen, J. W.** Syst. Beschr., 9:101, 1
1840 **Westwood, J. O.** Introduct. Class. Ins. Syn., p. 126
1846 **Rondani, Camillo.** Nouv. Ann. Sc. Nat. Bologna, S. 2; separate p. 13 (Neurolyga)
1864 **Schiner, J. R.** Fauna Austr. Dipt., 2:411
1870 **Winnertz, J.** Vehr. z.-b. Ges. Wien, 20:9–10
1876 **Bergenstamm, J. E., and Löw, Paul.** Syn. Cecidomyidarum, p. 17
1888 **Skuse, F. A. A.** Linn. Soc. N. S. Wales Proc., 3:133–34
1892 **Theobald, F. V.** Acct. Brit. Flies, 1:51, 86
1896 **Kieffer, J. J.** Misc. Entomol., 4:24
1897 ———— Syn. Cecid. Eur. & Alg., p. 50
1900 ———— Ent. Soc. Fr. Ann., 69:437, 442 (Neurolyga)
1908 **Meunier, F.** Soc. Sci. Brux. Ann., 28:8
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 312, 313
1911 ———— N. Y. Ent. Soc. Jour., 19:34

The unsatisfactory condition of this genus is briefly outlined in the above discussion of the tribe characteristics. We have provisionally given the genus supergeneric rank pending a satisfactory determination and description of the type species and have assigned thereto forms not readily grouped with more recently established genera, one or more of which may prove to be synonyms of Meigen's genus. Type C. flavipes Meign.

The first American species described is Say's Campylomyza scutellata which was very briefly characterized in 1823.[1]

The types are not extant and it would be very difficult to establish the identity of this species though Mr Ainslee[2] records this species swarming on wooden uprights in a timothy and clover meadow.

Campylomyza

a 13 antennal segments
  b Length .75 mm; abdomen brown; fifth antennal segment with a stem one-third the length of the basal enlargement.....
vitinea Felt, C. 759

[1] 1823 Say, Thomas. Acad. Nat. Sci. Phila. Jour., 3:17; 1883 Say, Thomas. Compl. Writ., 2:44

[2] 1908 Ainslee, C. N. Ent. Soc. Wash. Proc., 10:16–17

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aa 14 antennal segments

b Fifth antennal segment with a stem one-half the length of the basal enlargement

c Length 1 mm; abdomen fuscous yellowish; antennal segments asymmetrical, the middle claw denticulate..... producta Felt, C. 726

cc Length 1.5 mm; abdomen yellowish brown; antennal segments symmetrical; middle claw not denticulate..... pomifolia Felt, C. a379

bb Fifth antennal segment with a stem three-quarters the length of the basal enlargement

c Terminal clasp segment short, stout; pulvilli present

d Length .75 mm; abdomen dark brown; terminal clasp segment greatly swollen near the middle, the fourth palpal segment slender, twice as long as the preceding..... pomiflorae Felt, C. 11, 12, 13, 15

cc Terminal clasp segment long, more or less flattened; pulvilli absent

d Length .75 mm; abdomen dark brown; basal enlargement of fifth antennal segment with a length fully twice its diameter, the fourth palpal segment twice the length of the third, the base of the terminal clasp segment not greatly flattened and dilated.....cerasi Felt, C. 18

dd Length 1 mm; abdomen dark brown; basal enlargement of fifth antennal segment with a length about one-half greater than its diameter, the fourth palpal segment one-half longer than the third, the terminal clasp segment broad at base and strongly flattened.....gibbosa Felt, C. 162

bbb Fifth antennal segment with a stem fully as long as the basal enlargement

c Length 1 mm; abdomen pale reddish brown; fifth antennal segment with a stem one-quarter longer than the basal enlargement; terminal clasp segment swollen, with a length five times its diameter.....flavoscuta Felt, C. 117

cc Length 1 mm; abdomen dark reddish brown, terminal clasp segment stout, roundly quadrate apically, palpi quadriarticulate... truncata Felt, C. 1404

ccc Length .4 mm; abdomen dark brown; fifth antennal segment with a stem as long as the basal enlargement; terminal clasp segment stout, elongate, ovoid, palpi quadriarticulate..... modesta Felt, C. 147

cccc Length 1.25 mm; abdomen dark brown; fifth antennal segment with a length one-quarter greater than the basal enlargement; palpi triarticulate; terminal clasp segment stout, much produced, not dilated.....texana Felt, C. 1258, 888

aaa 15 antennal segments, the fifth with a stem one-fourth longer than the basal enlargement

b Length 1 mm; abdomen dark brown; mesonotum black..... carpini Felt, C. 107

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Campylomyza vitinea Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul 110, p. 98; separate, p. 2
1908 ———— N. Y. State Mus. Bul. 124, p. 314

This species was taken about grape, Vitis, or ash, Fraxinus, August 14, 1906, at Albany, N. Y.

Male. Length .75 mm. Antennae shorter than the body, sparsely haired, brown; 13 segments, the fifth with a stem one-third the length of the pyriform basal enlargement, the terminal two segments

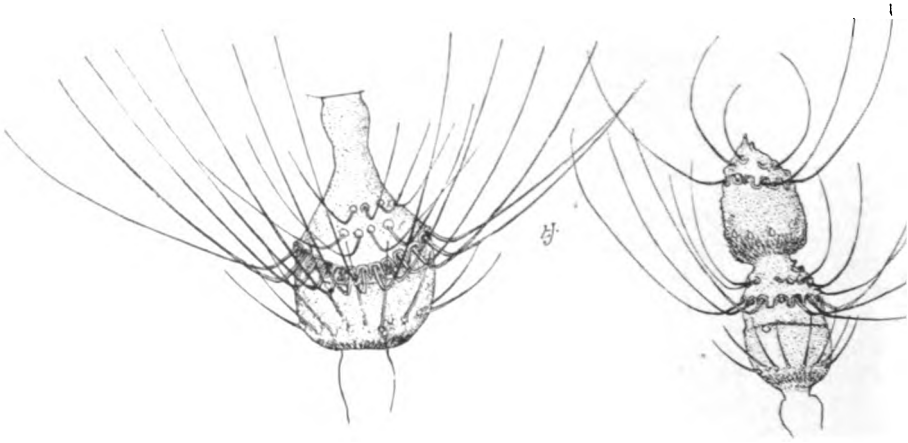


Fig. 42 Fifth and distal two antennal segments of male Campylomyza vitinea, enlarged. (Original)

partly fused. Palpi; the first segment long, swollen distally, the second slender, as long as the first, the third a little shorter. Mesonotum dark brown. Scutellum and abdomen brown, genitalia darker. Wings hyaline, costa light brown, subcosta uniting with the margin at the basal third. Halteres, femora and tibiae pale, tarsi darker; claws medium, curved at nearly right angles, denticulate. Genitalia; basal clasp segment stout, subtruncate; terminal clasp segment stout, short, broadly rounded. Type Cecid. 759.

Campylomyza producta Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 315

This form was taken on a window at Nassau, N. Y., July 31, 1906.

Male. Length 1 mm. Antennae extending to the fourth abdominal segment, thickly haired, dark brown, 14 segments; the fifth with a stem one-half the length of the subcylindric enlargement, which latter tapers distally; terminal segment narrowly oval. Palpi;

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the first segment somewhat elongate, enlarged, narrowly oval, the second more slender, longer, subrectangular, the third lanceolate and slightly shorter than the second, the fourth nearly twice the length of the third, more slender. Mesonotum dark brown, sub-

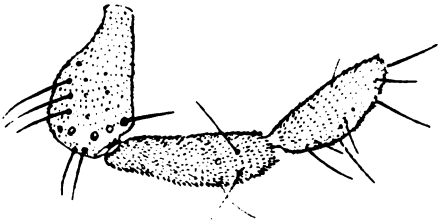


Fig. 43 Palpus of Campylomyza vitinea, enlarged. (Original)

median lines ornamented with short, yellowish setae; scutellum dark brown apically, postscutellum yellowish, dark brown laterally. Abdomen fuscous yellowish, genitalia brown, tipped with dull orange. Wings hyaline, costa dark brown. Halteres semitransparent basally, pale yellowish apically, coxae, femora and tibiae mostly pale semitransparent; femoro-tibio articulations and most of the tarsi pale orange; claws long, stout, the midpair minutely denticulate; pulvilli rudimentary. Genitalia: basal clasp segment short, broad, obliquely truncate; terminal clasp segment long, stout; irregular. Dorsal plate very broad, broadly rounded. Ventral plate broad at base, tapering, broadly rounded. Style long, slender. Type Cecid. 726.

Campylomyza pomifolia Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 315

A number of the small flies belonging to this species were taken on the under side of apple leaves, Pyrus malus at Nassau, N. Y., May 6, 1902.

Male. Length 1.5 mm. Antennae extending to the middle of the abdomen, sparsely haired, light brown, 14 segments; the fifth with a stem one-half the length of the subcylindric enlargement, which latter has a length nearly twice the diameter and tapers slightly, apically a pair of short stemmed disks; terminal segment somewhat reduced, narrowly ovate. Palpi; the first segment rather stout, subquadrate, the second one-half longer, more slender, the third reduced basally, as long and a little more slender than the second, the fourth one-half longer than the third, all rather thickly clothed with rather coarse setae. Halteres long, the distal portion prolonged. Legs probably a fuscous yellowish; claws long, strongly curved, simple; the pulvilli as long. Genitalia: basal clasp segment stout,

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obliquely truncate; terminal clasp segment long, stout, strongly constricted basally, broadly rounded. Dorsal plate long, broad, truncate. Ventral plate indistinct. Harpes short, stout, the ventral free portion broadly expanded, with irregular, angular projections anteriorly and posteriorly. Near the harpes are a pair of short, stout, strongly curved processes. Style short, narrowly rounded. Type Cecid. a379.

Campylomyza pomiflorae Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 99; separate, p. 3
1908 ———— N. Y. State Mus. Bul. 124, p. 315
1909 ———— Ent. Soc. Ont. 39th Rep't, p. 44

This species appears to be a very common, early spring form, since it was taken in numbers May 14, 1906, flying about the flowers of shadbush, Amelanchier canadensis, and also about the flowers of wild cherry, Prunus pennsylvanica, at Karner, N. Y.

Male. Length .75 mm. Antennae nearly as long as the body, thickly clothed with long hairs, dark brown; 14 segments, the fifth with a stem two-thirds the length of the subcylindric basal enlargement, apically a pair of oval, stemmed disks; terminal segment obconical, sometimes fused with the preceding, the apex scarcely produced. Palpi; the first segment rather long, broadly swollen distally and with a sensory organ on the internal distal surface, second more slender, as long as the first, the third a little longer than the second, slightly stouter, the fourth one-half longer than the third. Thorax and abdomen dark brown or black. Wings hyaline, iridescent, reddish at the insertion, anterior veins brown, subcosta uniting with the margin at the basal half; halteres whitish transparent. Legs brownish yellow, tarsi light yellow, tip of posterior tibiae, anterior tarsi and the terminal segments of the middle and posterior tarsi variably tinged with reddish; claws slender, simple. Genitalia; basal clasp segment stout, obliquely truncate; terminal clasp segment slender at base, broadly expanded distally, thickly setose apically. Dorsal plate broad, short, broadly rounded, ventral plate inconspicuous. Harpes with a convolute basal portion, a distal acute spine pointing in a latero-posterior direction and a submedian, recurved, fusiform, chitinous process extending anteriorly; style long, slender, irregularly curved. Type Cecid. 11.

Campylomyza cerasi Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 101; separate, p. 4
1908 ———— N. Y. State Mus. Bul. 124, p. 316

This species was taken May 15, 1906 in the vicinity of wild cherry, Prunus pennsylvanica, wild raspberry, Rubus sp., and various bushes at Nassau, N. Y.

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Male. Length .75 mm. Antennae as long as the body, sparsely haired, dark brown, annulate with lighter; 14 segments, the fifth with a stem three-fourths the length of the irregular, subcylindric enlargement; terminal segment slender, subconical. Palpi; the first segment short, stout, broadly rounded, second more slender, one-half longer, the third subequal, the fourth one-half longer than the third. Head, thorax and abdomen dark brown. Wings subhyaline, costa dark brown, subcosta uniting with the margin at the basal third; halteres yellowish transparent. Legs light brown with indistinct reddish markings at the articulations between the coxae and femora, the latter and tibiae, on the apex of the tibiae and with more or less suffused reddish tints on the tarsi; claws stout, slightly swollen near the middle, strongly curved, simple. Genitalia; basal clasp segment short, stout, ventral margin apparently produced as a recurved setose lobe; terminal clasp segment stout, curved. The dorsal plate apparently very broad, broadly and roundly excavated, the lobes widely separated, convolute laterally, irregularly and broadly rounded. Type Cecid. 18.

Campylomyza gibbosa Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 100; separate, p. 3
1908 ———— N. Y. State Mus. Bul. 124, p. 316

This species was taken June 7, 1906 on spruce, Picea canadensis, at Lake Clear, N. Y.

Male. Length 1 mm. Antennae longer than the body, dark brown, sparsely haired; probably 14 segments. Palpi; the first segment very much enlarged, broadly rounded, the second one-fourth longer than the first and slender, the third stouter, about two-thirds the length of the second and the fourth slender and a little longer than the second. Head, thorax and abdomen dark brown. Wings hyaline, costa dark brown, subcosta uniting with the margin at the basal third; halteres yellowish transparent. Legs pale straw, irregularly tinged with carmine, especially near the articulations; claws medium, strongly curved, pectinate. Genitalia; basal clasp segment very short, stout, truncate; terminal clasp segment longer than the basal clasp segment, greatly swollen basally, broadly rounded. Dorsal plate very broad, deeply emarginate, the lobes broadly rounded; ventral plate narrow, tapering, broadly rounded, sparsely haired. Harpes short, stout, irregularly convolute, with marginal conical projections; style short, stout, curved, narrowly rounded. Type Cecid. 162.

Campylomyza flavoscuta Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 97; separate, p. 1
1908 ———— N. Y. State Mus. Bul. 124, p. 313

This species was taken in general collecting at Albany, N. Y., June 4, 1906.

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Male. Length 1 mm. Antennae about as long as the body, sparsely haired light brown, probably 14 segments, the fifth with a stem one-fourth longer than the enlargement, which latter has a length twice its diameter. Palpi missing. Mesonotum yellowish brown. Scutellum reddish brown, postscutellum yellowish. Abdomen pale reddish brown. Wings hyaline, costa brown, subcosta uniting with the margin at the basal third; halteres yellowish transparent. Legs a nearly uniform pale fuscous yellow, first tarsal segment as long as the three following; claws slender, strongly curved, simple. Genitalia; basal clasp segment stout, obliquely truncate; terminal clasp segment small, swollen basally and tapering gradually to an obtuse point. Dorsal plate apparently very broad; ventral plate indistinct. Harpes apparently smooth, flattened, broadly rounded distally, the free ends approximate. Type Cecid. 117.

Campylomyza truncata Felt

1912 **Felt, E P.** N. Y. Ent. Soc. Jour., 20:102

Allied to the preceding and collected April 19, 1910 by Dr W. G. Dietz, Hazelton, Pa.

Campylomyza modesta Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 99; separate, p. 3
1908 ———— N. Y. State Mus. Bul. 124, p. 316

This species was taken June 7, 1906 on balsam, Abies balsamea, at Lake Clear, N. Y.

Male. Length .4 mm. Antennae probably twice as long as the body, sparsely haired, light brown; probably 14 segments, the fifth with a stem about one-fourth longer than the subglobular basal enlargement. Palpi probably quadriarticulate. Mesonotum dark brown. Scutellum, postscutellum and abdomen nearly concolorous. Wings subhyaline, costa dark brown, subcosta uniting with the margin at the basal half, base of wing reddish; halteres fuscous basally, yellowish fuscous apically. Legs a nearly uniform yellowish straw, tarsi tinged with carmine; claws slender, strongly curved, simple; pulvilli a little shorter than the claws. Genitalia; basal clasp segment stout, broadly rounded, truncate; terminal clasp segment stout, nearly oval. Dorsal and ventral plates indistinct; style short, stout. Type Cecid. 147.

Campylomyza texana Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 316

This species was taken at Plano, Texas, in November 1907 by Mr E. S. Tucker and apparently the same form was captured October 22d by Prof. T. D. A. Cockerell at Boulder, Col.

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Male. Length 1.25 mm. Antennae longer than the body, sparsely haired, dark brown; 14 segments, the fifth with a stem one-fourth longer than the subcylindric enlargement; terminal segment reduced, tapering to an acute apex. Palpi; the first segment short, stout, narrowly oval, with a large, irregularly oval sensory pit near the basal internal angle, second segment a little longer, more slender, the third longer and more slender than the second. The entire body a nearly uniform very dark brown. Wings hyaline, costa light brown, subcosta uniting with the anterior margin near the basal half. Halteres yellowish basally, light fuscous apically. Legs a light yellowish brown, the distal tarsal segments somewhat darker; claws long, slender, strongly curved, slightly denticulate, the pulvilli a little shorter than the claws. Genitalia; basal clasp segment short, stout, obliquely truncate; terminal clasp segment thickly haired, long, stout, slightly expanded and broadly rounded; dorsal plate short, stout, triangularly emarginate, lobes somewhat separated and broadly rounded, other organs apparently fused into an irregularly subquadrate process having conspicuous prolongations distally at the median and lateral angles. Type Cecid. 1258.

Campylomyza carpini Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 100; separate, p. 4
1908 ———— N. Y. State Mus. Bul. 124, p. 314

This species was taken on ironwood, Carpinus caroliniana, at Albany, N. Y., June 1, 1906.

Male. Length 1 mm. Antennae as long as the body, thickly haired, dark brown; 15 segments, the fifth with a stem one-fourth longer than the pyriform enlargement; the terminal two segments much reduced, narrowly fused, the fifteenth ovoid. Palpi; the first segment suborbicular, broad, the second twice the length of the first, elliptical oval, the third more slender, a little longer. Mesonotum black with submedian lines of fine hairs. Scutellum dark brown with sparse apical setae. Abdomen dark brown. Wings hyaline, costa and subcosta reddish brown, the latter uniting with the anterior margin at the basal half; halteres yellowish transparent. Legs pale grayish, tarsi variably tinged with reddish; claws stout, strongly curved, simple. Genitalia; basal clasp segment long, relatively slender, obliquely truncate; terminal clasp segment stout, short, with a long, apical tooth. Dorsal and ventral plates not easily distinguished. There appear to be a pair of suboval appendages within, much resembling the terminal clasp segment, though these structures may be a convolute portion of the very broad dorsal plate; if so, the ventral plate is a narrow, subtriangular process narrowly rounded distally; style slender, projecting anteriorly. Type Cecid. 107.

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Prionellus Kieff.

Prionota Kieff.

1894 **Kieffer, J. J.** Soc. Ent. Fr. Bul., p. 176
1895 ———— Soc. Ent. Fr. Bul., p. 318, 319
1896 ———— Mis. Ent., 4:7, 15
1897 ———— Syn. Cecid. Eur. & Alg., p. 49
1900 ———— Soc. Ent. Fr. Ann., v. 69, pl. 17, fig. 3; pl. 22, fig. 10
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:34

This genus was originally defined by Kieffer as recognizable by the subconical, subsessile antennal segments of the female and with the tip of costa nearer the second than the third vein. The palpi are quadriarticulate, the claws denticulate and the pulvilli well developed. Later, Kieffer states that the claws are arched and not or hardly dilated, while the antennal segments of the male are eccentric, with a stem about three-fourths the length of the basal enlargement and with crenulate whorls as well as whorls of hairs, the third vein extending to the apex of the wing. The basal clasp segment is stout, lobed internally, while the terminal clasp segment is stout

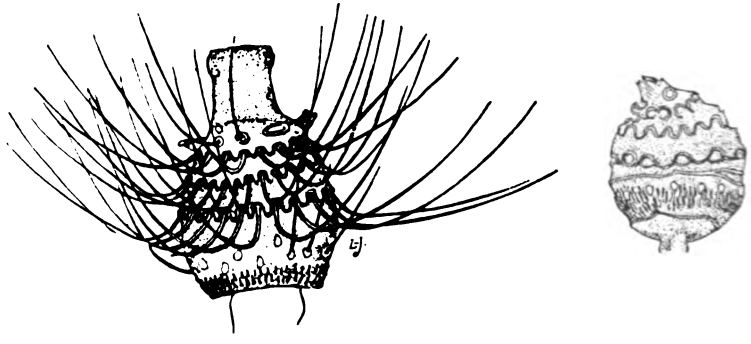


Fig. 44 Fifth and terminal antennal segments of Prionellus graminea, enlarged. (Original)

at the base, greatly expanded distally, swollen and broadly rounded apically. The female antennae are subconic or subovoid, with a very short stem and bearing subapically a broad, chitinous collar. The thickened anterior border of the wing extends almost to the fourth vein. Type Prionota pini Kieff. A number of American species have been provisionally referred to this genus.

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Key to species

a 12 antennal segments, subsessile; females
b Chitinous collar incised
c Length 1 mm; abdomen dark yellow; fifth antennal segment with a length one-quarter greater than its diameter, the fourth palpal segment one-half longer than the third..defectiva Felt, C. 715
bb Chitinous collar intact, not incised
c Wings long, narrow
d Length 1 mm; abdomen brownish yellow; fifth antennal segment with a length twice its diameter, the fourth palpal segment twice as long as the third.....silvana Felt, C. 883
dd Length 1 mm; abdomen dark brown; fifth antennal segment with a length one-half greater than its diameter, the fourth palpal segment one-half longer than the third.....
monilis n. sp., C. 1296
cc Wings medium or small
d Length 1 mm; abdomen fuscous yellowish; fifth antennal segment with a length one-third greater than its diameter, the fourth palpal segment one-half longer than the third.....
simulator Felt, C. 885
aa 13 antennal segments, sessile; females
b Chitinous collar rudimentary; fifth antennal segment with a length one-quarter greater than its diameter
c Length 1.5 mm; abdomen dark brown; fourth palpal segment one-quarter longer than the third.....longipennis Felt, C. 733w
bb Chitinous collar well developed; fifth antennal segment with a length one-half greater than its diameter
c Wings long, slender
d Fifth tarsal segment of the posterior leg with a length one and one-half to twice its diameter
e Length 1 mm; abdomen dark brown; fourth palpal segment one-half longer than the third; terminal lobe of the ovipositor broadly oval.....tsugae Felt, C. 166
dd Fifth tarsal segment of the posterior leg with a length 2 to 3 times its diameter
e Length 1.5 mm; abdomen dark brown; fourth palpal segment one-half longer than the third, dilated; terminal lobe of the ovipositor orbicular .....
boulderensis Felt, C. 886, c928, ? C. 1378
ee Length 2 mm; abdomen fuscous yellowish; fourth palpal segment one-half longer than the third, slender; terminal lobe of the ovipositor broadly oval. .....dilatata Felt, C. 1109
cc Wings broad
d Length 2.5 mm; abdomen dark reddish brown; fourth palpal segment twice as long as the third.....
latipennis Felt, C. a1457
aaa 14 antennal segments, stemmed; males
b Fifth antennal segment with a stem one-third the length of the basal enlargement

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c Langth 1.5 mm; abdomen dark brown; subcosta uniting with costa at the distal third; fourth palpal segment one-quarter longer than the third.....graminea Felt, C. 5

cc Length .75 mm; abdomen dark brown; subcosta uniting with costa at the basal third; fourth palpal segment with a length twice the third.....leguminicola Felt, C. 121

bb Fifth antennal segment with a stem three-quarters the length of the basal enlargement

c Length .75 mm; abdomen dark brown; wings narrow, the fourth palpal segment with a length twice the third.....hesperia Felt, C. 714

cc Length 1 mm; abdomen black; wings broad; fourth palpal segment with a length twice that of the third.....latipennis Felt, C. a1457

bbb Fifth antennal segment with a stem as long as the basal enlargement

c Length 1.5 mm; abdomen fuscous yellowish; fourth palpal segment with a length one-half greater than the third; basal clasp segment with an internal lobe.....dilatata Felt, C. 1109

cc Length 1.25 mm; abdomen fuscous; fourth palpal segment with a length one-half greater than the third; basal clasp segment without a lobe.....montana n. sp., C. a1951

Prionellus defectiva Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 314 (Campylomyza)

This species was taken on hemlock, Tsuga canadensis, at Newport, N. Y., July 27, 1906.

Female. Length 1 mm. Antennae extending to the fourth abdominal segment, thickly haired, dark brown, 12 segments; fifth subglobose, terminal segment slightly prolonged, narrowly rounded distally. Palpi; the first segment somewhat enlarged, subglobose, the second short, stout, subquadrate, the third a little longer, the fourth one-half longer than the third. Mesonotum dark brown, submedian lines sparsely haired, indistinct. Scutellum dark brown, postscutellum and abdomen dark fuscous yellowish, distal segments dark brown. Wings hyaline, costa dark brown, subcosta uniting with the margin near the middle. Halteres yellowish transparent; legs mostly fuscous yellowish, the tarsal articulations variably tinged with deep carmine; distal tarsal segments brown; metatarsus more than twice the length of the following segment; claws stout, strongly curved, denticulate; pulvilli as long as the claws. Ovipositor short, the terminal lobes triarticulate, the distal segment broadly oval. Type Cecid. 715.

Prionellus silvana Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 314 (Campylomyza)

This species was taken August 11, 1903 by Mr R. P. Currie at an altitude of 8000 feet on the Kokanee mountain, B. C.

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Female. Length 1 mm. Antennae scarcely extending to the base of the abdomen, sparsely haired, reddish brown; 12 segments, the fifth obpyriform, with a length one-half greater than its diameter; terminal segment produced, slightly constricted near the distal third at the chitinous collar. Palpi; the first segment short, stout, irregularly ovoid, the second stout, with a length about one-half greater than its diameter, the third about one-half longer than the second, more slender, the fourth about twice as long as the third, greatly dilated. Mesonotum rather dark reddish brown. Scutellum and postscutellum lighter. Abdomen brownish yellow. Wings long, narrow, hyaline, costa a light brown, subcosta uniting with the anterior margin near the basal half. Legs a variable light yellowish; claws long, slender, strongly curved, with 4 or 5 long denticulations; pulvilli as long as the claws. Ovipositor short, the terminal lobes triarticulate, the third segment broadly oval. Type Cecid. 883.

Prionellus monilis n. sp.

This species was reared in November 1907 by Mr E. S. Tucker from a cage sown with oats.

Female. Length 1 mm. Antennae extending to the third abdominal segment, thickly haired, dark brown; 12 segments, the fifth with a length one-third greater than its diameter; terminal segment greatly produced, constricted and evidently composed of two closely fused. Palpi; first segment stout, broadly oval, the second narrowly oval, the third a little longer, more slender, the fourth one-half longer than the third. Mesonotum dark brown, the submedian lines sparsely haired. Scutellum and postscutellum brown. Abdomen dark brown, the basal segments yellowish brown. Wings hyaline, costa light brown, subcosta joining the margin at the basal half, the third vein near the apex. Halteres yellowish transparent. Legs a variable fuscous yellowish, the distal tarsal segments brownish; claws strongly curved, denticulate, the pulvilli longer than the claws. Ovipositor short, the lobes triarticulate, the third segment broadly oval, all sparsely haired. Type Cecid. 1296.

Prionellus simulator Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 314 (Campylomyza)

This species was taken June 26, presumably 1903, by Mr R. P. Currie at Kaslo, B. C.

Female. Length 1 mm. Antennae hardly extending to the base of the abdomen, thickly haired, yellowish brown; 12 segments, the fifth subsessile, subcylindric, with a length about one-third greater than its diameter; terminal segment somewhat produced and tapering to a rounded apex. Palpi; the first segment greatly expanded distally, pyriform, the second a little longer, slender, narrowly rounded apically, the third a little longer and more slender than the second,

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the fourth one-half longer than the third, somewhat dilated. Mesonotum dark brown. Scutellum, postscutellum and abdomen fuscous yellowish, the latter dark brown distally. Wings hyaline, costa dark brown, subcosta uniting with the anterior margin near the basal half. Legs a fuscous yellowish; claws long, rather slender, strongly curved, finely denticulate, pulvilli longer than the claws. Ovipositor short, triarticulate; the third segment broadly oval. Type Cecid. 885.

Prionellus longipennis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 314 (Campylomyza)

This species was taken on an office window August 2, 1906 at Albany, N. Y.

Female. Length 1.5 mm. Antennae extending to the base of the abdomen, thickly haired, brown, 13 segments; the fifth subsessile, pyriform; terminal segment somewhat reduced, nearly pyriform. Palpi; the first segment enlarged, subglobose, the second smaller, nearly oval, the third one-half shorter, broadly oval, the fourth a little longer, slender, elliptical. Mesonotum dark brown, submedian lines indistinct. Scutellum dark reddish brown, postscutellum light reddish brown. Abdomen dark brown, the distal segments darker, and with the incisures and pleurae pale orange, the sclerites not sharply defined. Wings hyaline, costa light brown, subcosta uniting with the margin at the basal third. Halteres yellowish basally, fuscous apically, the legs a nearly uniform light brown, shaded with fuscous distally, tarsal segments dark brown; claws stout, curved, denticulate; pulvilli wanting. Ovipositor short, the lobes biarticulate, basal segment irregular, subquadrate, the distal one narrowly oval. Type Cecid. 733.

Prionellus tsugae Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 101; separate, p. 5 (Campylomyza)

1908 ———— N. Y. State Mus. Bul. 124, p. 314 (Campylomyza)

This species was taken June 7, 1906 on hemlock, T s u g a c a n a d e n s i s, at Lake Clear, N. Y.

Female. Length 1 mm. Antennae extending to the base of the abdomen, thickly haired, dark brown; 13 segments; fifth subcylindric, with a length one-half greater than its diameter, terminal segment subcylindric, tapering roundly to a slightly produced apex; Palpi; the first segment, pyriform, greatly enlarged distally, the second and third subequal, suboval, the fourth one-half longer than the third. Mesonotum dark brown, submedian lines with pale hairs. Scutellum yellowish brown. Abdomen dark brown. Wings hyaline, costa dark brown, subcosta uniting with the margin at the basal

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half; halteres probably whitish transparent. Legs a nearly uniform dark straw, terminal segments slightly darker; claws stout, strongly curved, serrate. Ovipositor short, the basal segment subquadrate, the second broadly oval. Type Cecid. 166.

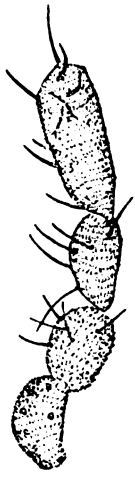


Fig. 45 Palpus of Prionellus tsugae, enlarged. (Original)



Fig. 46 Distal tarsal segments of Prinellus tsugae, enlarged. (Original)

Prionellus boulderensis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 314 (Campylomyza)

This species was taken by Prof. T. D. A. Cockerell at Boulder, Col., October 15th. Apparently the same species was taken for the United States National Museum at Corvallis, Ore., May 18, 1896.

Female. Length 1.5 mm. Antennae extending to the second abdominal segment, thickly haired, reddish brown; 13 segments, the fifth with a length one-half greater than its diameter, the distal fourth, tapering; terminal segment somewhat reduced, tapering to a short, stout, rounded knob. Palpi; the first segment short, stout, broadly oval, with a conspicuous sensory organ on its internal face, the second about as long as the first, rather stout, rounded distally, the third a little longer and more slender than the second, the fourth about one-half longer than the third, somewhat dilated; body a nearly uniform dark brown. Wings hyaline, costa light brown; subcosta uniting with the margin just beyond the basal half. Legs dark fuscous yellowish, the tarsal segments somewhat lighter; claws long, strongly curved, denticulate, the pulvilli as long as the claws. Ovipositor short, triarticulate, the third segment broadly oval. Type Cecid. 886.

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Prionellus dilatata Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 149 (Campylomyza)
1908 ———— N. Y. State Mus. Bul. 124, p. 316 (Campylomyza)
1909 ———— Ent. Soc. Ont. 39th Rep't, p. 44 (Campylomyza)

This species was reared by the late Dr M. T. Thompson of Clark University, Worcester, Mass., from a vial containing decaying vegetable matter and seeds.

Male. Length 1.5 mm. Antennae nearly as long as the body, sparsely haired, fuscous yellowish; 14 segments, the fifth with a stem as long as the subglobose basal enlargement; terminal segment reduced, pyriform. Palpi; the first segment short, stout, irregularly oval, the second a little longer, more slender, the third slightly longer than the preceding and the fourth one-half longer than the third, strongly flattened; face fuscous yellowish. Mesonotum dark

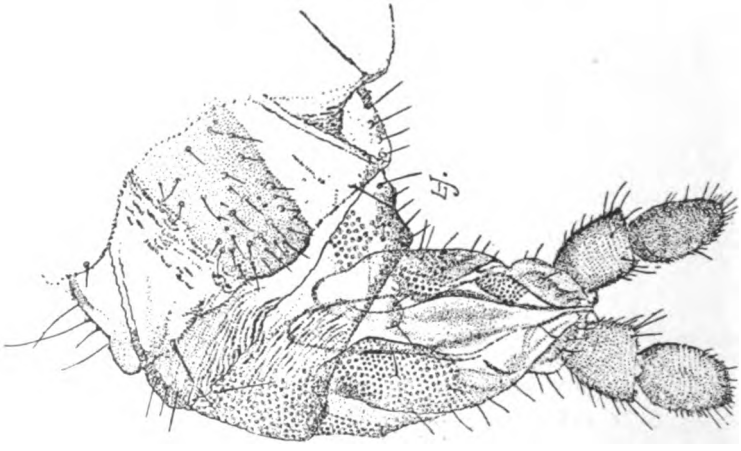


Fig. 47 Distal abdominal segments and ovipositor of Prionellus tsugae, enlarged. (Original)

brown. Scutellum yellowish, postscutellum fuscous yellowish. Abdomen a variable fuscous yellowish. Wings hyaline, costa light brown, subcosta uniting with the anterior margin near the middle. Halteres pale yellowish. Legs a nearly uniform light fuscous yellowish; claws long, strongly curved, denticulate, the pulvilli as long as the claws. Genitalia; basal clasp segment broad, truncate and with a long, roundly triangular lobe at the internal distal angle; terminal clasp segment short, stout, greatly dilated, subtriangular; dorsal plate narrow, tapering, narrowly rounded. Harpes stout, the distal margin bearing a pair of long, stout, recurved, teeth.

Female. Length 2 mm. Antennae extending to the base of the abdomen, sparsely haired, light fuscous yellowish; 13 segments, the fifth subsessile, subcylindric; with a length one-half greater than

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its diameter, the distal two segments closely fused, obtusely rounded apically. Palpi; the first segment short, stout, irregularly oval, the second a little longer, much more slender, the third longer and slightly stouter than the second, the fourth one-half longer and more slender than the third; face light fuscous yellowish. Mesonotum a fuscous yellowish. Scutellum a little lighter, postscutellum fuscous yellowish. Abdomen a light fuscous yellowish. Wings hyaline, costa pale straw, subcosta uniting with the margin near the basal half. Halteres yellowish transparent. Legs pale yellowish, the distal tarsal segments darker; claws long, strongly curved, denticulate, the pulvilli as long as the claws. Ovipositor short, triarticulate, the third segment broadly oval. Type Cecid. 1109.

Prionellus latipennis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 314 (Campylomyza)

The male and female of this species were taken on a small pine, probably Pinus rigida, at Karner, N. Y., April 27, 1907. They were observed pairing, consequently there can hardly be any question as to their belonging to the same species.

Male. Length 1 mm. Antennae nearly as long as the body, thickly haired, dark brown; 14 segments, the fifth with a stem two-thirds the length of the subcylindric basal enlargement; terminal segment narrowly oval, subacute distally. Palpi; the first segment broadly oval, with a rather conspicuous sense organ internally, the second a little longer, narrow, subquadrate, the third a little shorter, more slender than the second, the fourth about twice the length of the preceding, more slender; face fuscous, eyes large, black. Mesonotum shining black, sparsely and irregularly clothed with short, yellowish hairs. Scutellum a dark reddish brown, postscutellum and abdomen nearly shining black, sparsely clothed with fine, yellowish hairs. Wings hyaline, costa reddish brown, subcosta uniting with the margin at the middle. Halteres nearly uniform fuscous yellowish. Legs fuscous yellowish, the incisures variably tinged with deep red, the distal tarsal segment reddish brown; claws long, strongly curved, denticulate, the pulvilli longer than the claws. Genitalia; basal clasp segment long, stout, tapering; terminal clasp segment rather long, almost pediceled, broadly rounded and with an enlargement near the distal third; dorsal plate broad, tapering, broadly rounded. Harpes short, stout, approximate, with an acute, chitinous spine posteriorly and a semicircular, dark, chitinous thickening dorsally.

Female. Length 2.5 mm. Antennae extending to the base of the abdomen, thickly haired, dark reddish brown; 13 segments, the fifth subsessile; terminal segment prolonged, subcylindric, tapering to an obtuse apex. Palpi; the first segment stout, broadly rectangular with a conspicuous sense organ internally, second a little longer, more slender, the third as long as the second, more

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slender, the fourth fully twice the length of the preceding, slightly enlarged at the distal third; face fuscous. Mesonotum black, sparsely and irregularly clothed with short, yellowish hairs. Scutellum reddish brown, postscutellum very dark brown. Abdomen sparsely clothed with fine, yellowish hairs, dark reddish brown, the incisures pale fuscous yellowish. Wings hyaline, costa light brown, subcosta uniting with the margin near the middle. Halteres pale orange basally, pale yellowish distally. Legs a nearly uniform dark brown; claws long, slender, strongly curved, denticulate, the pulvilli longer than the claws. Ovipositor short, triarticulate, the third segment suborbicular. Type Cecid. a1457.

Prionellus graminea Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 98; separate, p. 2 (Campylomyza)

1908 ———— N. Y. State Mus. Bul. 124, p. 315 (Campylomyza)

This dark brown male was swept from grass etc. at Karner, N. Y., April 27, 1906.

Male. Length 1.5 mm. Antennae two-thirds the length of the body, sparsely haired, dark brown; 14 segments, fifth with a stem one-fourth the length of the subglobular enlargement; terminal segment subglobular, acute apically. Palpi; the first segment, sub-

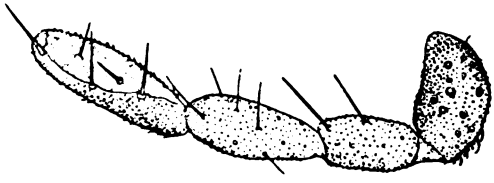


Fig. 48 Palpus of Prionellus graminea, enlarged. (Original)

quadrate, slightly enlarged distally, second and third subequal, the latter a trifle longer, the fourth one-half longer than the third. Head and thorax black or dark brown. Abdomen dark brown, pleurae and incisures yellowish brown. Wings hyaline, slightly fuscous, tinted with reddish basally, costa dark brown, subcosta uniting with the margin at the distal third; halteres semitransparent. Legs yellowish transparent or reddish; claws stout, strongly curved, pectinate. Genitalia; basal clasp segment short, stout, truncate; terminal clasp segment short, stout, broadly rounded. Dorsal and ventral plates indistinct. Harpes very broad, slightly expanded, deeply emarginate and with the internal angles produced. Style short, broad, tapering, narrowly rounded. Type Cecid. 5.

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Prionellus leguminicola Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 98; separate, p. 2 (Campylomyza)
1908 ———— N. Y. State Mus. Bul. 124, p. 315 (Campylomyza)

This species was swept from red clover, Trifolium pratense, at Albany, N. Y., June 4, 1906.

Male. Length .75 mm. Antennae extending to the second abdominal segment, sparsely haired, reddish brown; 14 segments, the the fifth with a stem one-third the length of the subcylindric basal enlargement; terminal segment obtusely rounded apically. Palpi; the first segment large, subquadrate, slightly swollen distally, the second shorter, subglobular, the third a little longer, suboval, the fourth twice the length of the preceding, subrectangular; face dark brown. Mesonotum dark brown. Scutellum and postscutellum reddish brown. Abdomen dark brown or black. Wings hyaline, costa pale straw basally, dark brown apically, subcosta uniting with the margin at the basal third; halteres whitish transparent. Femora and tibiae brownish straw color, lighter ventrally, tarsi a pale straw color, terminal segment darker; claws stout, strongly curved, those on the second and third pairs of legs denticulate. Genitalia; basal clasp segment short, stout, truncate; terminal clasp segment short, greatly swollen at the distal third. Dorsal plate broad, broadly rounded. Harpes strongly chitinized, broad, tapering to a heavy, chitinized, apex with an acute prolongation laterally, one posteriorly on the median line and another internally and posteriorly; style slender, broadly rounded. Type Cecid. 121.

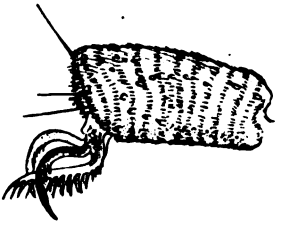


Fig. 49 Distal tarsal segment of Prionellus leguminicola, enlarged. (Original)

Prionellus hesperia Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 315 (Campylomyza)

This form was taken on hemlock, Tsuga canadensis, at Newport, N. Y., July 27, 1906.

Male. Length .75 mm. Antennae nearly as long as the body, sparsely haired, dark brown, 14 segments; the fifth with a stem three-fourths the length of the pyriform basal enlargement, rather stout, bladelike chitinous processes arise from apical oval pits; terminal segment slightly reduced, the distal portion long, slender, fusiform. Palpi; the first segment slightly enlarged, subglobose, the second longer, irregularly rectangular, the third one-half longer than the second, broader, the fourth nearly twice as long as the third and broader. Head, thorax and abdomen a nearly

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uniform dark brown or black. Mesonotum shining. Wings hyaline, costa dark brown, subcosta uniting with the margin just before the basal half. Halteres pale yellowish; legs mostly pale yellowish transparent, the tarsal articulations variably tinged with carmine; the distal segments darker; metatarsus of the fore and middle legs scarcely twice the length of the following segment; claws rather slender, strongly curved, denticulate; the pulvilli as long as the claws. Genitalia: basal clasp segment short, stout, obliquely truncate; terminal clasp segment short, stout, constricted at the base, narrowly rounded. Dorsal plate broad, broadly rounded. (Plate 12, figure 3.) Type Cecid. 714.

Prionellus montana n. sp.

This small form was taken by Prof. T. D. A. Cockerell at Boulder, Col., April 25, 1909.

Male. Length 1.25 mm. Antennae a little longer than the body, thickly haired, fuscous; 14 segments, the fifth with a stem as long as the subcylindric basal enlargement, which latter has a length one-half greater than its diameter; terminal segment somewhat reduced, narrowly rounded. Palpi; first segment stout, subquadrate, the second a little longer, more slender, the third longer than the second, more slender, the fourth one-half longer than the third, slender. Thorax and abdomen a nearly uniform fuscous, the latter sparsely haired. Wings hyaline, costa fuscous, subcosta uniting therewith beyond the basal half, the third vein at or a little beyond the apex. Halteres yellowish. Legs a fuscous yellowish, the fourth and fifth tarsal segments a variable brown; claws long, stout, very strongly curved, minutely denticulate, the pulvilli longer than the claws. Genitalia; basal clasp segment stout, obliquely truncate; terminal clasp segment greatly dilated, subtriangular, the apex slightly recurved; dorsal plate broad, broadly rounded apically, ventral plate apparently slightly bilobed. Harpes conspicuous, dilated, heavily chitinized. Type Cecid. a1951.

Aprionus Kieff.

1894 **Kieffer, J. J.** Soc. Ent. Fr. Bul., 176
1895 ———— Soc. Ent. Fr. Bul., p. 318, 319
1896 ———— Mis. Ent., 4:7, 17
1897 ———— Syn. Cecid. Eur. & Alg., p. 49
1900 ———— Soc. Ent. Fr. Ann. v. 69, pl. 17, fig. 1, 2; pl. 23, fig. 15; pl. 24, fig. 5, 7, 12
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour. 19:34

This genus, as originally defined, has the antennal segments subconical, subsessile in the female, the thickened portion of costa approaching nearer the fourth than the third vein. Palpi quadriarticulate, claws simple, the pulvilli wanting. Later it was stated that the claws were arched and not or hardly dilated, while the

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palpi were tri- to quadriarticulate. The eccentric antennal segments are ornamented with hyaline lamellae in addition to crenulate whorls, while the third vein joins costa at the apex. The rudimentary pulvilli do not extend beyond the middle of the claws. The lobes of the ovipositor are triarticulate. Kieffer states that this genus differs from Prionellus by the simple character of the claws and the short or rudimentary pulvilli.

The nymph of A. miki Kieff., as illustrated by the author, is extremely interesting. There are the usual pair of slender, cephalic appendages, the smooth dorsum of the thorax is ornamented with two lines of stout setae arising from small tubercles, while the dorsum of the abdominal segments appears to be regularly marked with transverse rows of short, stout, chitinous points, the posterior margin being ornamented with a sparse row of short, stout, chitinous setae and the posterior angles of segments 2 to 8 bearing long, filiform appendages, each having a length about twice that of the segment. The terminal segment is produced as a pair of stout, subconic appendages, the lateral and internal angles of each bearing a short, stout spine. Type Apriona bidentata Kieff. No American species have been recognized.

Monardia Kieff.

1894 **Kieffer, J. J.** Mis. Ent., 4:7, 22
1895 ———— Soc. Ent. Fr. Bul., p. 318, 319
1897 ———— Syn. Cecid. Eur. & Alg., p. 50
1900 ———— Soc. Ent. Fr. Ann., v. 69, pl. 17, fig. 4, 9; pl. 18, fig. 3; pl. 23, fig. 6; pl. 24, fig. 6
1904 **Meunier, F.** Soc. Sci. Brux. Ann., 28:9
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:35

The North American members of this group are most easily recognized by the subapical whorls of mushroomlike appendages, termed stemmed disks, on the antennal segments. Kieffer states that members of this genus may be distinguished by the minute subapical tooth of the claws, a character which in our experience appears to be so insignificant or evanescent as to prove of comparatively slight service. The type of this genus is M. stirpium Kieff.

The members of this group present considerable variations in the number of antennal segments, especially in the female, they ranging from 11 in M. gilletti Felt to 22 in M. articulosa Felt. The known males have 14 or 16 stemmed antennal segments. The palpi may be either tri- or quadriarticulate. The wings present the typical venation of Campylomyza. The pulvilli may be as long as the claws or rudimentary. Near the posterior extremity of the abdomen the females have a pair of submedian, ventral, globular or trumpet-shaped glands. The ovipositor is short and indistinctly

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tri- or quadriarticulate. The male genitalia are stout with a short, swollen terminal clasp segment. The one reared American species, M. lignivora Felt, was obtained from the fungous affected heartwood of a pine, the larvae undoubtedly using the rather stout breast bone to erode irregular cavities in the affected wood.

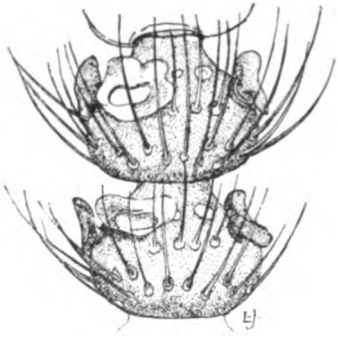


Fig. 50 Fifth and sixth antennal segments of female Monardia lignivora, enlarged. (Original)

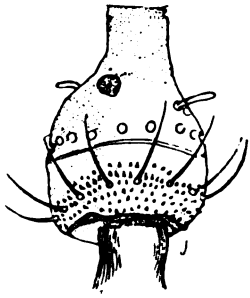


Fig. 51 Fifth antennal segment, views from o posite sides, of Monardia lignivora, ma enlarged. (Original)



Key to species

a 11 antennal segments, subsessile; females

b Length 1.2 mm; abdomen fuscous yellowish; fifth antennal segment with a length equal to its diameter, the third palpal segment one-third longer than the second.....gilletti Felt, C. 1239a

aa 12 antennal segments, subsessile; females

b Length 2 mm; abdomen fuscous yellowish; fifth antennal segment with a length one-quarter greater than its diameter, the third palpal segment one-quarter longer than the second.....toxicodendron Felt, C. 122

bb Length .75 mm; abdomen fuscous yellowish; fifth antennal segment with a length one-quarter greater than its diameter; fourth palpal segment with a length one-half greater than the third.....alexanderi n. sp., C. 1370

aaa 14 antennal segments

b Antennal segments subsessile

c Length 2 mm; abdomen fuscous yellowish; fifth antennal segment with a length one-half greater than its diameter, the fourth palpal segment as long as the third.....pinicorticis Felt, C. 799

bb Fifth antennal segment with a stem one-third the length of the basal enlargement; males; subcosta uniting with costa at the basal third

c Length 1.5 mm; abdomen reddish brown; terminal clasp segment plainly pyriform.....karnerensis Felt, C. 29

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cc Length 1 mm; abdomen dark brown; terminal clasp segment only slightly enlarged apically.....populi Felt, C. 115

bbb Fifth antennal segment with a stem one-half the length of the basal enlargement; subcosta uniting with costa at the basal half

c Length .75 mm; abdomen dark brown; fourth palpal segment twice the length of the third....balsamicola Felt, C. 145

bbbb Fifth antennal segment with a stem three-quarters the length of the basal enlargement; male; subcosta uniting with costa just beyond the basal half

c Length 1.5 mm; abdomen reddish brown; fourth palpal segment with a length one-half greater than the third..... barlowi Felt, C. 798

bbbbb Fifth antennal segment with a stem as long as the basal enlargement

c Length 1.25 mm; abdomen dark brown; fourth palpal segment with a length one-half greater than the third..... tuckeri Felt, C. 1259

aaaa 16 antennal segments

b Length 1.3 mm; abdomen dark reddish; fifth antennal segment with a stem one-third the length of the basal enlargement, the third palpal segment only a little longer than the second; male.. lignivora Felt, C. a1614

aaaaa 21 antennal segments, subsessile; female

b Length 2.5 mm; abdomen dark red; fifth antennal segment with a length one-half greater than its diameter, the fourth palpal segment a little longer than the third..... lignivora Felt, C. a1614

aaaaaa 22 antennal segments, subsessile; female

b Length 2.5 mm; abdomen light brown; fifth antennal segment with a length three-quarters its diameter; fourth palpal segment with a length one-half greater than the third..... articulosa Felt, C. 884

Monardia gilletti Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 314 (Campylomyza)

This species was taken on a window at Albany, N. Y., September 11, 1907.

Female. Length 1.2 mm. Antennae extending to the base of the abdomen, thickly haired, light brown; 11 segments, the fifth pyriform, with a length less than its diameter; terminal segment produced, broadly rounded. Palpi; the first segment short, stout, roundly subquadrate, the second a little longer and more slender, the third one-third longer than the second, more slender. Mesonotum dark brown. Thorax dark brown. Abdomen fuscous yellowish. Wings hyaline, costa yellowish brown, subcosta uniting with the anterior margin near the basal third. Halteres fuscous yellowish. Coxae and legs a variable fuscous yellowish; claws long, slender, strongly curved, simple, the pulvilli about as long as the

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claws. The venter of the seventh segment with submedian, subglobose organs, the ovipositor short, triarticulate; terminal segment narrowly oval. Type Cecid. 1239a.

Monardia toxicodendron Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 98; separate, p. 1-2 (Campylomyza)

1908 ———— N. Y. State Mus. Bul. 124, p. 314 (Campylomyza)

This species was taken on poison ivy, Rhus toxicodendron, at Albany, N. Y., June 4, 1906.

Female. Length 2 mm. Antennae hardly extending to the base of the abdomen, thickly clothed with whitish hairs, dark brown;

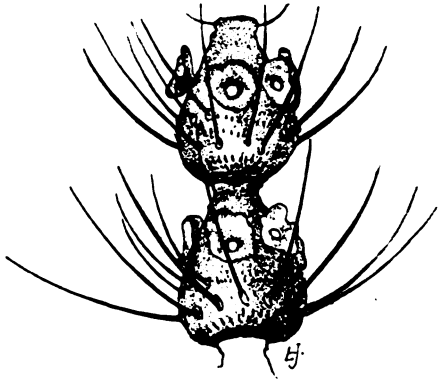


Fig. 52 Seventh and eighth antennal segments of Monardia toxicodendron, enlarged. (Original)

12 segments, the fifth pyriform; terminal segment much shortened, obliquely rounded distally. Palpi; the first segment subglobular, second one-half longer, lanceolate, the third one-quarter longer,

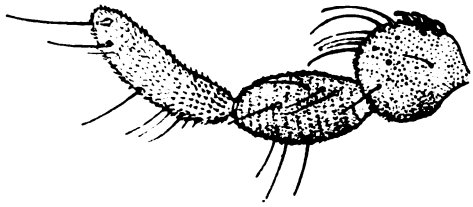


Fig. 53 Palpus of Monardia toxicodendron, enlarged. (Original)

more slender. Mesonotum dark brown, the posterior median area yellowish brown, submedian lines ornamented with pale hairs. Scutellum and postscutellum pale reddish yellow, the former with

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sparse yellowish hairs. Abdomen pale fuscous yellowish, terminal segment and ovipositor dark brown or black. Wings hyaline, costa pale straw, subcosta uniting with the margin at the basal third; halteres yellowish transparent. Legs a nearly uniform pale straw

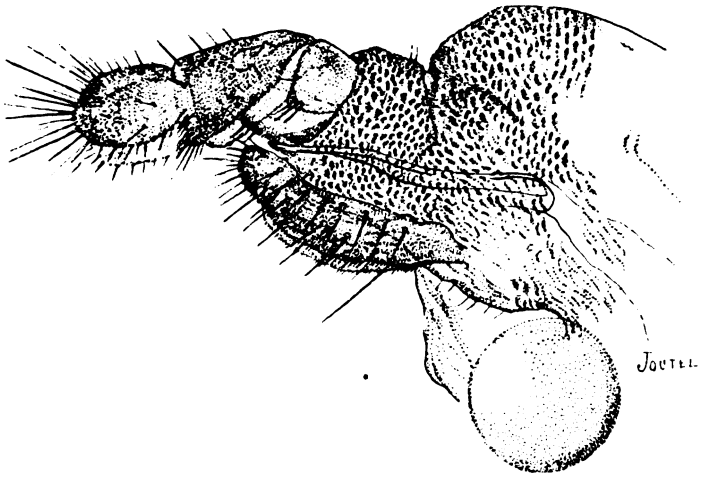


Fig. 54 Apex of abdomen showing ovipositor of Monardia toxicodendron, enlarged. (Original)

yellow; claws slender, strongly curved, simple. On the venter of the eighth abdominal segment, a pair of irregular, trumpet-shaped, fuscous organs. Ovipositor short, triarticulate, terminal lobe suboval. Type Cecid. 122.

Monardia alexanderi n. sp.

This species was taken by Mr C. P. Alexander on Sport island, Sacandaga river, N. Y., July 25, 1909.

Female. Length .75 mm. Antennae extending to the base of the abdomen, sparsely haired, deep red; 12 segments, the fifth with a length one-quarter greater than its diameter, the eleventh and twelfth segments narrowly fused, the latter somewhat reduced. Palpi probably quadriarticulate, the penultimate narrowly oval, with a length three times its width, the terminal segment one-half longer. Mesonotum dull black. Scutellum and postscutellum apparently concolorous. Abdomen fuscous yellowish. Costa pale straw, subcosta uniting therewith near the basal half. Halteres whitish transparent. Legs mostly pale straw, the tarsi variably tinged with reddish, the distal segments darker; claws strongly curved, slightly swollen subapically; pulvilli as long as the claws; ventral glands globose. Ovipositor short; terminal segment narrowly oval, with a length three times its width. Type Cecid. 1370.

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Monardia pinicorticis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 315 (Campylomyza)
1909 ———— Ent. Soc. Ont. 39th Rep't, p. 44 (Campylomyza)

This species was reared from the galleries of a Scolytid in pine, Pinus sp., taken at Riverton, N. J., April 14, 1901 by Prof. C. W. Johnson.

Female. Length 2.5 mm. Antennae hardly extending to the base of the abdomen, sparsely clothed with fine hairs, light brown; 14 segments, the fifth pyriform, with a length one-half greater than its diameter; terminal segment reduced, acute apically. Palpi; the first segment rather long, broadly oval, the second a little shorter, narrow, the third considerably shorter and more slender than the preceding and the fourth more slender and nearly as long as the third. Mesonotum and scutellum reddish brown, the former sparsely and evenly clothed with fine, yellowish hairs, postscutellum dark brown. Abdomen fuscous yellowish, sparsely clothed with fine, yellowish hairs. Wings hyaline, costa light brown, subcosta uniting with the margin near the middle of the wing. Halteres and legs mostly fuscous yellowish, the distal tarsal segments somewhat darker. Metatarsus more than twice the length of the preceding segment. Claws short, stout, strongly denticulate, pulvilli rudimentary. Ovipositor short, triarticulate, the third segment short, broadly oval. Type Cecid. 799.

Monardia karnerensis Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 101; separate, p. 5 (Campylomyza)
1908 ———— N. Y. State Mus. Bul. 124, p. 315 (Campylomyza)

This reddish brown species was taken at Karner, N. Y., May 16, 1906.

Male. Length 1.5 mm. Antennae half the length of the body (probably broken) sparsely haired, dark brown; probably 14 segments, the fifth with a stem one-third the length of the subcylindric basal enlargement. Palpi; the first segment subquadrate, stout, the second as long, broadly oval, the third a little longer and the fourth one-half longer than the third. Mesonotum dark brown with submedian lines sparsely clothed with setae. Abdomen reddish brown. Wings subhyaline, the veins brown, subcosta uniting with the margin at the basal third; halteres yellowish transparent. Legs semitransparent with irregular, reddish bands on the tarsi and at the tip of the tibiae, particularly on the mid and posterior legs; claws strongly curved, pectinate. Genitalia; basal clasp segment short, stout, obliquely truncate; terminal clasp segment short, greatly swollen distally. Dorsal plate broad, tapering, broadly rounded; ventral plate indistinct. Harpes broad at base, curving

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to a heavy, apical process with an acute, outward curved point distally and anteriorly a heavy, slender, chitinous spine, and slightly laterally a flattened, broadly rounded lobe parallel with the spine and nearly as long; style short, slender, the apex broadly rounded. (Plate 12, figure 1.) Type Cecid. 29.

Monardia populi Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 98–99; separate, p. 2 (Campylomyza)

1908 ———— N. Y. State Mus. Bul. 124, p. 315 (Campylomyza)

This species was taken on the large-toothed poplar, Populus grandidentata, at Albany, N. Y., June 4, 1906.

Male. Length 1 mm. Antennae extending to the second abdominal segment, dark brown, sparsely long haired; 14 segments, the fifth with a stem one-third the length of the subcylindric enlargement; terminal segment obconic, the apex slightly produced. Palpi; the first segment stout, broadly expanded distally, the second more slender, one-half longer, the third a little longer than the second, the fourth one-half longer than the third. Mesonotum dark brown. Scutellum and postscutellum a little lighter. Abdomen dark brown, very sparsely clothed with fine, yellowish hairs. Wings hyaline, costa dark brown, subcosta uniting with the margin at the basal third; halteres whitish transparent. Legs a nearly uniform light slaty brown, claws stout, strongly curved, pectinate. Genitalia; basal clasp segment stout, obliquely truncate; terminal class segment stout, greatly expanded distally. Dorsal plate broad, broadly rounded. Harpes stout, expanded distally, the posterior margin slightly excavated, the internal angle produced as a short, acute spine; style stout, short, slightly expanded, broadly and roundly excavated. (Plate 13, figure 1.) Type Cecid. 115.

Monardia balsamicola Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 99; separate, p. 3 (Campylomyza)

1908 ———— N. Y. State Mus. Bul. 124, p. 315 (Campylomyza)

This species was taken on balsam, Abies balsamea, at Lake Clear, N. Y., June 7, 1906.

Male. Length .75 mm. Antennae nearly as long as the body, dark brown, sparsely long haired; 14 segments, the fifth with a stem one-half the length of the subglobular basal enlargement; terminal segment subconical. Palpi; the first segment subglobular, second as long as the first, suboval, the third a little more slender, as long as the second, the fourth more than twice the length of the third. Mesonotum, scutellum, postscutellum and abdomen nearly uniform dark brown. Wings hyaline, costa light brown, subcosta

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uniting with the margin at the basal half; halteres whitish transparent. Legs nearly uniform straw brown; claws stout, strongly curved, pectinate. Genitalia; basal clasp segment stout, obliquely truncate; terminal clasp segment greatly enlarged and broadly rounded. Dorsal plate about one-half the width of the entire segment, broadly rounded. Harpes stout, subtriangular basally, broadly and roundly excavated laterally at the posterior third, apically broadly rounded internally and with a conspicuous beak at the external posterior angle. (Plate 12, figure 2.) Type Cecid. 145.

Monardia barlowi Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 316 (Campylomyza)

This species was taken May 2, 1904 by Prof. John Barlow at Kingston, R. I. Apparently the same species has been taken at Aweme, Manitoba, N. W. T., and at Hazleton, Pa.

Male. Length 1.5 mm. Antennae extending to the third abdominal segment, thickly long haired, dark brown; 14 segments, the fifth with a stem three-fourths the length of the subcylindric basal enlargement; terminal segment reduced, irregularly obtuse distally. Palpi; the first segment short, stout, irregularly oval, the second a little longer, subrectangular, the third a trifle longer, more slender, the fourth one-half longer than the third, more slender. Mesonotum dark brown, submedian lines sparsely clothed with fine, yellowish hairs. Scutellum dark brown. Abdomen reddish brown, rather thickly clothed with yellowish hairs. Wings hyaline, costa light brown, subcosta uniting with the margin just beyond the basal half. Halteres and legs a nearly uniform fuscous yellowish, the distal tarsal segments somewhat darker; claws short, stout, strongly curved, denticulate, the pulvilli as long as the claws. Genitalia; basal clasp segment short, stout, a conspicuous lobe at the internal distal angle, terminal clasp segment narrowed and prolonged at the base, swollen distally, broadly rounded; dorsal plate broad, broadly rounded. Harpes apparently consisting of two subrectangular, irregular plates with the internal and distal margins, the latter strongly excavated, heavily chitinized. Type Cecid. 798.

Monardia tuckeri Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 316 (Campylomyza)

This species was taken in November 1907 at Plano, Texas, by Mr E. S. Tucker.

Male. Length 1.25 mm. Antennae longer than the body, sparsely haired, dark brown; 14 segments, the fifth with a stem as long as the subcylindric basal enlargement, which latter has a length one-half greater than its diameter; terminal segment reduced, tapering, obtuse. Palpi; the first segment short, stout, irregularly oval, the second as long as the first, slender, the third a little longer and stouter than the second, the fourth one-half longer and more slender

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than the third. Entire body a nearly uniform dark brown. Wings hyaline, costa light brown; subcosta uniting with the anterior margin near the basal half. Halteres yellowish basally, light fuscous apically. Legs a light yellowish brown, the distal tarsal segments somewhat darker; claws long, slender, strongly curved, simple, the pulvilli as long as the claws. Genitalia; basal clasp segment short, stout, the internal distal angle produced as a long, roundly tapering process; terminal clasp segment short, stout, greatly dilated near the basal third, broadly rounded. Dorsal plate long, stout, broadly rounded. Harpes short, broad, each with a pair of long retrorse spines; style long, slender, subacute. Type Cecid. 1259.

Monardia lignivora Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 100; separate, p. 4 (Campylomyza)
1908 ———— N. Y. State Mus. Bul. 124, p. 314, 315 (Campylomyza)
1909 ———— Ent. Soc. Ont. 39th Rep't, p. 44 (Campylomyza)

Many larvae and a number of adults of this interesting form were taken September 21, 1906 in the fungus-affected heartwood of an 18 inch hard pine, Pinus rigida, at Davidson's River, N. C. The tree had been cut into the 20th of the preceding July for the purpose of observing the progress of a fungus affection. This undoubtedly gave the gnats an opportunity to enter and at the time of their discovery they had worked their way among the spongy tissues. The flies had probably oviposited in crevices and galleries a considerable distance from the cut surface. Larvae, pupae and adults were found in the affected wood at least three inches above the cut and fully two inches behind the deepest part. The affected wood, either as the result of fungous attack or because of the operations of the Cecid larvae, was quite spongy and contained numerous lenticular cavities. It was well charged with pitch. The Dipterous larvae appeared to erode the smooth surface of the wood, even that apparently hard and sound and, as a result, produced quantities of very fine, yellowish wood powder. Full-grown larvae to the number of fifteen to twenty were taken in a smooth channel about 6 mm in diameter and 5 cm long. Other larvae occurred singly and the same was true of pupae. Exuviae or pupal skins were so numerous on portions of the cut surface as to literally cover it, especially the more spongy portions.

Larva. Length 6 mm, slender, light salmon. Head small; antennae stout, apparently uniarticulate; breastbone stout, well developed, tridentate, the median tooth largest, the shaft slender, slightly expanded distally. Skin nearly smooth; the segments posteriorly with transverse rows of minute spines as in Miastor larvae. Terminal segment broadly rounded. (Plate 13, figure 4.)

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Pupa. Length 5 mm. The head and thorax are reddish or dark brown, the abdomen a light salmon.

Exuviae. Length 3.5 mm, pale whitish; antennal cases short, stout; cephalic horns very slender; wing cases extending to the second abdominal segment; leg cases to the third and fourth abdominal segments. Abdomen dorsally, thickly ornamented with minute, chitinous points; posterior extremity reduced, narrowly rounded.

Male. Length 1.3 mm. Antennae extending to the fourth abdominal segment, sparsely long haired, light brown; 16 segments, the fifth pyriform, with a stem one-third the length of the enlargement; terminal segment reduced. Palpi yellowish, the first segment subglobular, second and third subequal, subquadrate, the fourth one-half longer than the preceding. Mesonotum black, sparsely clothed with short, fine, silvery hairs, laterally with a few long, black hairs, submedian lines indistinct. Scutellum and postscutellum dark brown. Abdomen dark red, the dorsal sclerites slightly ferruginous, sparsely clothed with short setae. Genitalia very dark brown. Wings subhyaline, costa dark brown, subcosta uniting with the margin at the basal third; halteres fuscous basally, yellowish apically. Legs a nearly uniform fuscous yellowish, claws heavy, slightly curved, simple. Genitalia; basal clasp segment broad, short; terminal clasp segment short, swollen at the middle. Dorsal plate large, triangular, tapering; ventral plate smaller, angulate, deeply emarginate, the lobes widely separated, acute and with conspicuous lateral prolongations at the basal half.

Female. Length 2.5 mm. Antennae extending to the base of the abdomen, densely yellow-haired, yellowish brown; 21 segments, the fifth subsessile, nearly disc-shaped. Palpi yellowish, the first segment short, subquadrate, second and third subequal, elongate oval, the fourth a little longer. Color practically as in the male. Ventrally near the middle of the eighth abdominal segment, there is a pair of submedian irregular, trumpet-shaped organs. Ovipositor triarticulate, terminal lobe orbicular. Type Cecid. a1614.

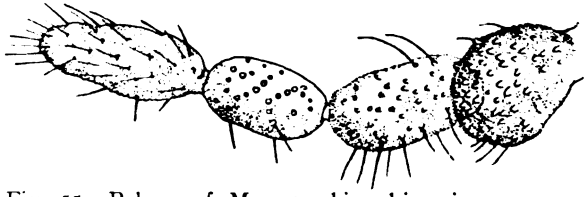


Fig. 55 Palpus of Monardia lignivora, enlarged. (Original)

Monardia articulosa Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 315 (Campylomyza)

This unique species from the United States National Museum, was taken in the White mountains by Morrison.

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Female. Length 2.5 mm. Antennae extending to the base of the abdomen, thickly haired, reddish brown; 22 segments, the fifth subsessile, subglobose; terminal segment produced, a knob apically. Palpi; the first segment, somewhat produced, pyriform, the second

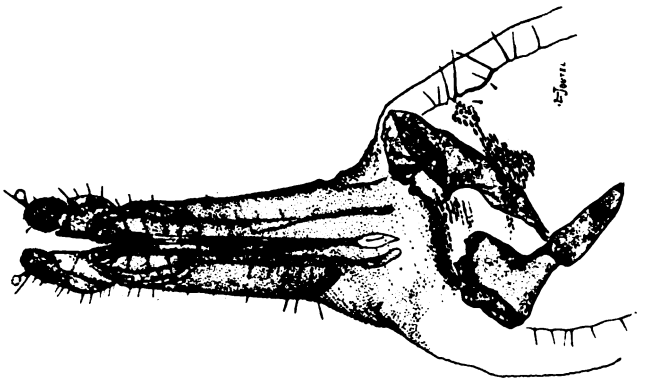


Fig. 56 Apex of abdomen, showing submedian ventral organs and ovipositor of Monardia lignivora, enlarged. (Original)

stout, narrowly oval, the third a little longer than the second, more slender, the fourth one-half longer than the third, more slender. Mesonotum dark brown. Abdomen light brown. Wings rather long, broad, hyaline, costa dark brown, subcosta uniting with the margin near the basal third. Coxae and femora fuscous.yellowish, tarsi light yellowish; claws long, slender, strongly curved, simple, the pulvilli nearly as long as the claws. Ovipositor short, the venter of the seventh segment with a pair of submedian, subglobose organs; terminal lobes triarticulate; the third segment long, tapering to a narrowly rounded apex. Type Cecid. 884.

Bryomyia Kieff.

1896 **Kieffer, J. J.** Mis. Ent., 4:7, 15
1895 ———— Soc. Ent. Fr. Bul., p. 318
1897 ———— Syn. Cecid. Eur. & Alg., p. 49
1900 ———— Soc. Ent. Fr. Ann., v. 69, pl. 17, fig. 6
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:35

Members of this genus have the claws bent at right angles and distinctly enlarged near the distal third. The pulvilli are very long, straight, and the flagellate antennal segments are each provided with a long stem in both sexes. The typical species has 10 segments in the female and 14 in the male, those of the latter eccentric and ornamented with crenulate whorls. The terminal antennal segments of the female, as illustrated by Kieffer, are subconical, with several irregular subbasal whorls of short, stout setae and subapically a pair of stout, chitinous, reniform appendages on either

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side of the segments. The palpi are quadriarticulate and the anterior border of the wing is continued to a point near the fourth vein. The terminal clasp segment of the male is short, swollen and obtuse apically. Type B. bergrothi Kieff. Representatives of this genus are not known to occur in America.

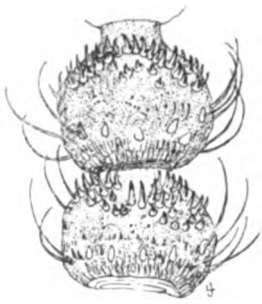


Fig. 57 Fourth and fifth antennal segments of Cordylomyia brevicornis, enlarged. (Original)

Cordylomyia Felt

1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:35

This genus is represented by a series of species with short antennae and is most easily recognized, especially in the female, by the subapical, frequently thick whorls of short, stout, occasionally recurved spines. These organs are less apparent in the male, though rudiments of a whorl may be seen in at least one species placed in this group. The type of this genus is C. coprophila Felt.

Key to species

a 11 subsessile antennal segments; females
b Subcosta uniting with the margin at the distal third
c Length 2 mm; abdomen fuscous yellowish, unicolorus; fifth antennal segment subglobose, short haired..bryanti Felt, C. 796
cc Length 1 mm; abdomen fuscous yellowish, reddish basally; fifth antennal segment pyriform, rather slender, long haired.....sylvestris Felt, C. a1620
ccc Length 1.5 mm; abdomen reddish brown; antennal segments stout luna Felt, C. 547
bb Subcosta uniting with the margin at the basal half
c Fifth antennal segment cylindric, with a length three-fourths its diameter
d Length 2 mm; eleventh antennal segment about the same length as the tenth; fourth palpal segment slender.....brevicornis Felt, C. 725, 756, 882, 889, 1229
dd Length 2.5 mm; eleventh antennal segment nearly twice the length of the tenth, strongly constricted near the middle; fourth palpal segment swollen apically.....tumida n. sp., C. 1216
cc Length 1 mm; fifth antennal segment cylindric, with a length one-fourth greater than its diameter..coprophila Felt, C. 890
ccc Length 2 mm; fifth antennal segment cylindric, with a length twice its diameter.....coloradensis n. sp., C. 1386, 1387
aa 12 antennal segments, subsessile; females

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b Length 1 mm; scutellum reddish brown; abdomen fuscous yellowish
versicolor Felt, C. 617
bb Length 2 mm; scutellum dark brown; abdomen fuscous yellowish
americana n. sp., C. 887
bbb Length 1.25 mm; scutellum and abdomen dark brown.....
kasloensis Felt, C. 881

aaa 14 antennal segments, male
b Fifth antennal segment with a stem three-fourths the length of the basal enlargement, length 1.25 mm; abdomen a variable brown.....coprophila Felt, C. 890
bb Fifth antennal segment with a stem one-fourth longer than the basal enlargement; length 1.5 mm; abdomen dark brown.....
coloradensis n. sp., C. 1386, 1387

Cordylomyia bryanti Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 313 (Campylomyza)

This species was taken August 18, 1905, at Little River, Newfoundland, by Mr Owen Bryant.

Female. Length 2 mm. Antennae scarcely extending to the base of the abdomen, thickly fine haired, dark brown; 11 segments, the fifth subglobose, subsessile; terminal segment produced, constricted at the distal third, subacute apically. Mesonotum dark reddish brown, the submedian lines sparsely clothed with fine hairs. Scutellum apparently yellowish brown. Abdomen a fuscous yellowish, sparsely clothed with very fine, yellowish hairs. Wings hyaline, costa reddish brown, subcosta uniting with the margin at the distal third. Halteres yellowish basally, fuscous brown apically. Legs a nearly uniform fuscous yellowish, the distal tarsal segments darker; claws long, stout, strongly curved, minutely denticulate, the pulvilli longer than the claws; ovipositor short, the terminal lobes triarticulate, the third segment narrowly oval. (See plate 11, figure 5.) Type Cecid 796.

Cordylomyia sylvestris Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 97; separate, p. 1 (Campylomyza)
1908 ———— N. Y. State Mus. Bul. 124, p. 313 (Campylomyza)

This species was taken on the window of a woodland hut at Davidson's River, N. C., September 23, 1906.

Female. Length 1 mm. Antennae extending to the base of the abdomen, sparsely haired, yellowish; 11 segments, the fifth pyriform; the last segment compound. Palpi; the basal segment subpyriform; the second and third subequal, the fourth as long as the two preceding. Face fuscous. Mesonotum reddish brown, submedian lines indistinct. Scutellum lighter, postscutellum dark brown. Abdomen dull yellowish with the basal segment reddish,

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the distal ones dark brown. Wings hyaline, costa dark brown, subcosta uniting with the margin at the apical third. Halteres yellowish basally, fuscous apically. Legs fuscous yellowish, first tarsal segment longer than the following two, others successively shorter; claws heavy, strongly curved, finely serrate. Ovipositor moderately long, terminal lobes consisting of a subquadrate basal segment and an orbicular distal one. Type Cecid. a1620.

Cordylomyia luna Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 313 (Campylomyza)

This species was taken on a hotel window at Westfield, N. Y., July 11, 1906.

Female. Length 1.5 mm. Antennae very short, sparsely haired, dark brown, 11 segments; the fifth subsessile, subcylindric, with a length three-fourths its diameter; the eleventh segment constricted near the middle and with a broad, rounded process apically. Palpi; the first segment short, subglobose; the second narrowly lanceolate, the third a little stouter, subequal, the fourth nearly twice the length of the third, curved distally. Mesonotum dark brown, submedian lines lighter, sparsely haired. Scutellum and postscutellum dark brown. Abdomen a nearly uniform reddish brown, sparsely clothed with fine setae. Wings hyaline, costa dark brown, subcosta uniting with the margin near the middle. Halteres fuscous brown, legs a nearly uniform dark fuscous yellowish, the distal tarsal segments dark brown; metatarsus more than twice the length of the following segment; claws stout, strongly curved, simple; the pulvilli longer than the claws. Ovipositor short, triarticulate, the third segment nearly orbicular. Type Cecid. 547.

Cordylomyia brevicornis Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110, p. 97; separate, p. 1 (Campylomyza)

1908 ———— N. Y. State Mus. Bul. 124, p. 314 (Campylomyza)

This species appears to be a very common and widely distributed form, since it was taken in July and August 1906 on a window at Nassau, N. Y., and appears to have been collected by H. G. Dyar at Kaslo, B. C. There are specimens in the National Museum from Jacksonville, Fla.

Female. Length 2 mm. Antennae one-fourth the length of the body, thickly haired, reddish brown; 11 segments, the fifth subcylindric, the length hardly equaling the diameter. Palpi; the first segment subglobular, second and third segments narrowly oval, subequal, fourth nearly twice the length of the third. Mesonotum dark brown, submedian lines indistinct. Scutellum and postscutellum dark reddish brown. Abdomen reddish brown, membrane and

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pleurae dark salmon, ovipositor dark brown. Wings hyaline, costa reddish brown, subcosta uniting with the margin at the basal half; halteres pale reddish brown. Legs dark reddish brown, tarsi

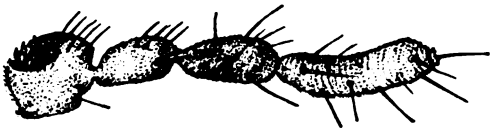


Fig. 58 Palpus of Cordylomyia brevicornis, enlarged. (Original)

lighter, distal segments dark brown; claws moderate, strongly curved, minutely denticulate. Ovipositor moderately long, terminal lobes triarticulate. Type Cecid. 756.

Cordylomyia tumida n. sp.

This species was taken on a window at Albany, N. Y., June 25, 1907.

Female. Length 2.5 mm. Antennae not extending to the base of the abdomen, thickly haired, dark brown; 11 segments, the fifth subsessile, subglobose, with a length three-fourths its diameter; terminal segment produced, slightly constricted near the middle, obtuse apically. Palpi; the first segment irregularly subglobose, second one-half longer than the first, much more slender, the third a little shorter and stouter than the second and the fourth fully twice as long as the third, strongly flattened and somewhat expanded distally. Mesonotum dark brown, the submedian lines indistinct. Scutellum reddish brown, postscutellum a little darker. Adbomen brown, the incisures and pleurae a variable orange or yellowish. Wings hyaline, costa light brown, subcosta uniting with the anterior margin near the basal half. Halteres yellowish basally, fuscous apically. Legs fuscous yellowish, the tarsi variably tinted with carmine; claws long, slender, strongly curved, finely denticulate, the pulvilli longer than the claws. Ovipositor short, triarticulate, the basal segment subquadrate, the second subtriangular, the third irregularly orbicular. Described from an alcoholic specimen. Type Cecid. 1216.

Cordylomyia coprophila Felt

1909 **Felt, E. P.** Ent. Soc. Ont. 39th Rep't, p. 44 (MS) (Campylomyza)
1911 ———— N. Y. Ent. Soc. Jour., 19:35

This small species was reared from manure at Washington, D. C., January 28, 1882.

Male. Length 1.25 mm. Antennae longer than the body, thickly haired, light brown; 14 segments, the fifth with a stem three-fourths the length of the cylindric basal enlargement, which latter has a length about three-fourths its diameter; a thick subbasal whorl

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of setae and on the apical half, 3 crenulate whorls, the distal 2 rudimentary; apically an irregular group of stout, curved, chitinous spines; terminal segment reduced, narrowly oval. Palpi; the first segment stout, with a length about twice its diameter, the second about three-fourths the length of the first, narrowly oval, the third a little longer and more slender and the fourth longer, strongly flattened, dilated. Mesonotum dark brown. Scutellum reddish brown. Abdomen a variable brown, the segments narrowly margined posteriorly with dark brown. Wings hyaline, costa light brown, subcosta joining costa near the basal half; the third vein just before the apex, the fourth just beyond the apex; the fifth unites with the posterior margin near the distal third, its branch at the basal third; crossvein at the distal third of subcosta. Legs fuscous yellowish; claws long, stout, strongly curved, simple, the pulvilli longer than the claws. Genitalia; basal clasp segment stout, obliquely truncate; terminal clasp segment stout, slightly swollen near the middle, very broadly rounded apically; dorsal plate short, broad, broadly rounded. Harpes with an apical group of 5 or 6 short, stout, recurved spines. (Plate 13, figure 3.)

Female. Length 1 mm. Antennae thickly haired, fuscous yellowish; 11 segments, the fifth subsessile, the enlargement cylindric, with a length one-fourth greater than its diameter; subbasal whorl sparse, the subapical band of setae short, scattering, covering the distal half; terminal segment produced, slightly constricted near the middle, broadly rounded apically. Mesonotum dark brown. Scutellum fuscous yellowish, postscutellum dark brown. Abdomen fuscous yellowish, dark brown distally. Legs light yellowish brown. Ovipositor short, the terminal lobes probably triarticulate. Type Cecid. 890.

Cordylomyia versicolor Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 314 (Campylomyza)

This species was taken on tick trefoil, Desmodium grandiflorum, at Albany, N. Y., July 17, 1906.

Female. Length 1 mm. Antennae extending to the base of the abdomen, sparsely haired, dark brown, fuscous basally; 11 segments, the fifth pyriform; the last two segments fused, the distal one subfusiform. Palpi; the first segment stout, rather long, swollen distally, the second a little longer, more slender, the third fusiform; face dark brown. Mesonotum dark brown, submedian lines indistinct. Scutellum reddish brown, postscutellum and abdomen fuscous yellow, the latter dark brown apically, sparsely clothed with pale yellowish hairs. Wings hyaline, costa light brown, subcosta uniting with the margin at the basal third; halteres yellowish basally, fuscous apically. Legs a nearly uniform straw brown; claws long, strongly curved, apparently with a short, stout tooth basally. Ovipositor short, the terminal lobes with a stout basal subquadrate portion and a distal narrowly oval lobe. Type Cecid. 617.

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Cordylomyia americana n. sp.

This species was taken at Boulder, Col., October 15th by Prof. T. D. A. Cockerell.

Female. Length 2 mm. Antennae extending to the base of the abdomen, sparsely haired, dark brown, at least 9, probably 12 segments, the fifth subsessile, subcylindric, with a length one-half greater than its diameter. Palpi; the first segment greatly swollen, broadly rounded, the second a little shorter than the first, narrowly oval, the third a little longer than the second and the fourth nearly twice the length of the third, rather strongly flattened. Mesonotum dark brown. Abdomen a fuscous yellowish green, darker distally. Wings hyaline, costa light brown, subcosta uniting with the margin just before the middle. Legs a variable fuscous yellowish; claws long, slender, strongly curved, minutely denticulate, the pulvilli as long as the claws. Ovipositor short, the terminal lobe short, stout, triangular, narrowly rounded distally. Type Cecid. 887.

Cordylomyia kasloensis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. p. 314 (Campylomyza)

This species was taken by Mr R. P. Currie June 11, presumably 1903, at Kaslo, B. C.

Female. Length 1.25 mm. Antennae extending to the fourth abdominal segment, sparsely haired, dark brown; 12 segments, the fifth pyriform, with a length three-fourths the diameter. Palpi; the first segment short, stout, greatly dilated apically, pyriform, the second one-half longer than the first, slender, the third a little longer and more slender than the second. Body a nearly uniform dark reddish brown. Wings hyaline, costa dark brown, subcosta uniting with the anterior margin near the basal half. Legs fuscous yellowish, tarsi darker; claws long, slender, strongly curved, simple, pulvilli as long as the claws. Ovipositor short, triarticulate, the basal segment irregularly ovoid, the second elongate, triangular, the third broadly oval. Type Cecid. 881.

Cordylomyia coloradensis n. sp.

This species was taken on a window in October 1910 by Prof. T. D. A. Cockerell at Boulder, Col.

Male. Length 1.5 mm. Antennae a little longer than the body, sparsely haired, dark brown; 14 segments, the fifth with a stem one-quarter longer than the pyriform enlargement, which latter has a length a little greater than its diameter; terminal segment conical, with a length twice its diameter, not fused with the preceding. Palpi; the third segment with a length about three times its width, the fourth one-half longer. Mesonotum, scutellum, postscutellum and abdomen a nearly uniform dark brown. Costa light brown,

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subcosta uniting therewith at the basal half. Halteres yellowish transparent. Coxae dark brown; femora, tibiae and tarsi mostly fuscous yellowish, the distal tarsal segment darker; claws stout, strongly curved, notched subapically, the pulvilli nearly as long as the claws. Genitalia; basal clasp segment stout, obliquely truncate; terminal clasp segment long, broadly rounded, dorsal plate short, broadly emarginate, the lobes subtruncate. Harpes stout, bidentate.

Female. Length 2 mm. Antennae extending to the second abdominal segment, rather thickly haired, reddish brown; 11 segments, the fifth subsessile, with a length about twice its diameter; eleventh segment distinctly constricted beyond the middle, evidently composed of two, the distal portion being narrowly oval. Palpi; first segment greatly swollen, irregularly oval, the second with a length over twice its width, the third as long as the second, subtruncate distally, the fourth one-half longer than the second. Mesonotum dark brown. Scutellum reddish brown, postscutellum concolorous. Abdomen sparsely haired, fuscous yellowish, the ovipositor slightly fuscous. Costa dark brown. Halteres yellowish transparent, slightly fuscous apically. Coxae dark brown; femora and tibiae fuscous straw, the second, third and fourth tarsal segments lighter, the fifth reddish brown, the eighth abdominal segment ventrally with a pair of submedian, subglobose bodies. Ovipositor short, triarticulate, the third segment orbicular. Type Cecid. 1386, 1387.

Corinthomyia Felt

1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:35

This group represents a form of specialization most easily recognized by the series of subequal whorls of stout, curved setae on the subsessile, flagellate segments, differing very greatly from the typical crenulate whorls so commonly present in Campylomyzine males. The venation is typical of Campylomyza. The pulvilli are as long as the claws. Males only are known. The type species is Campylomyza hirsuta Felt.

Key to species

a Fifth antennal segment with a length one-half greater than its diameter

b Length 1.25 mm; abdomen reddish brown; 6 short, stout whorls hirsuta Felt, C. 729

bb Length 1.5 mm; abdomen reddish brown, 4 to 5 short, stout whorls gracilis Felt, C. 1406

bbb Length 2 mm; abdomen reddish brown; 7 short, stout whorls..... cincinna n. sp., C. 1220

aa Fifth antennal segment with a length three-fourths greater than its diameter

b Length 1 mm; abdomen dark brown; 5 short, stout whorls..... currei Felt, C. 881a

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Corinthomyia hirsuta Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 315 (Campylomyza)

This species was taken on an office window at Albany, N. Y., August 1, 1906.

Male. Length 1.25 mm. Antennae shorter than the body, sparsely haired, dark brown, 14 segments; the fifth with a stem one-fourth the length of the subglobose enlargement, subbasal whorl thick, 6 nearly equidistant whorls of stout, strongly curved setae; terminal segment reduced, pyriform. Palpi; the first segment subglobose with a conspicuous sense organ subbasally, the second a little longer, subrectangular, the third somewhat longer, slender at the base, the fourth one-half longer than the third. Mesonotum dark brown, submedian lines indistinct. Scutellum and postscutellum dark reddish brown. Abdomen dark brown. Wings hyaline, costa light brown, subcosta uniting with the margin at the basal half. Halteres pale yellowish basally, fuscous apically; legs mostly a uniform light brown; claws long, slender, strongly curved; pulvilli a little longer. Genitalia; basal clasp segment short, stout, obliquely truncate; terminal clasp segment strongly constricted at the base, greatly enlarged and broadly oval distally. Dorsal plate apparently very long, broad, broadly and irregularly rounded. Type Cecid. 729.



Fig. 59 Fourth antennal segment of Corinthomyia cincinna, enlarged. (Original)

Corinthomyia gracilis Felt

1912 **Felt, E. P.** N. Y. Ent. Soc. Jour., 20:102–3

This species was taken at Hazelton, Pa., May 18, 1910 by Dr W. G. Dietz. Type Cecid. 1405.

Corinthomyia gracilis Felt

This species was taken on an office window at Albany, N. Y., July 5, 1907.

Male. Length 2 mm. Antennae nearly as long as the body, sparsely haired, dark brown; 14 segments, the fifth subsessile, with a stem one-fifth the length of the subcylindric basal enlargement, which latter has a length one-half greater than the diameter; seven equidistant, thickly set, crenulate whorls; terminal segment prolonged, with a length fully twice its diameter. Palpi; the first segment short, stout, broadly oval, with a distinct sense organ internally, the second more slender, one-half longer, the third a little longer than the second and the fourth one-half longer than the third,

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dilated apically; face thickly clothed with grayish setae. Mesonotum dark brown, shining. Scutellum reddish brown, postscutellum a little darker. Abdomen brownish yellow, genitalia fuscous. Wings hyaline, costa light brown; subcosta uniting with the anterior margin near the basal half. Halteres yellowish basally, fuscous apically. Legs a fuscous straw; claws rather long, slender, strongly curved, the concavity finely denticulate, the pulvilli as long as the claws. Genitalia; basal clasp segment short, stout, obliquely truncate; terminal clasp segment short, stout, greatly swollen near the distal fourth, obtusely rounded apically. Type Cecid. 1220.

Corinthomyia currei Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 315 (Campylomyza)

This species, studied through the courtesy of the United States National Museum, was taken at Kaslo, B. C., by Mr R. P. Currie.

Male. Length 1 mm. Antennae extending to the fourth abdominal segment, thickly haired, dark brown; 14 segments, the fifth with a smooth stem one-fourth the length of the subcylindric basal enlargement, which latter has a length three-quarters greater than its diameter, 5 crenulate whorls; terminal segment slightly produced, narrowly rounded apically. Palpi; the first segment narrowly oval, the second stout, one-half longer, the third about as long as the second, more slender, the fourth one-half longer than the third, somewhat dilated. Body a nearly uniform dark brown. Wings hyaline, costa reddish brown, subcosta uniting with the anterior margin at the basal half. Legs fuscous yellowish; claws long, slender, strongly curved, finely denticulate, the pulvilli longer than the claws. Genitalia; basal clasp segment short, stout, obliquely truncate; terminal clasp segment with a short, narrow neck, greatly swollen apically, the inner face flattened, greatly dilated and produced basally to form a distinct angle; dorsal plate long, extremely broad, the posterior margin produced mesially. (Plate 13, figure 2.) Type Cecid. 881a.

HETEROPEZINAE

This subfamily comprises a number of exceedingly peculiar forms, some of them most remarkable on account of the great degree of specialization by reduction. Members of this heteromorphic group may be separated from the Itonididinae by the absence of circumfili, and from the Lestremiinae by the great reduction in venation, there being at most, four (rarely over three) long veins. The metatarsus may be longer than the following segment, while the number of tarsal segments may be reduced to two. Certain species have quinquearticulate tarsi and the wing membrane thickly clothed with rather broad, striate scales. Others have the wing membrane hyaline and clothed with short, erect hairs, quite distinct from the

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long, appressed ones found in the Itonididinae. The ocelli are wanting. The Heteropezinae, like the Lestremiinae, appear to depend to a considerable extent upon the olfactory organs.

Nothing was known concerning the life history of our American species till the writer studied several forms. Miastor americana Felt was reared from under bark, in an incipient stage of

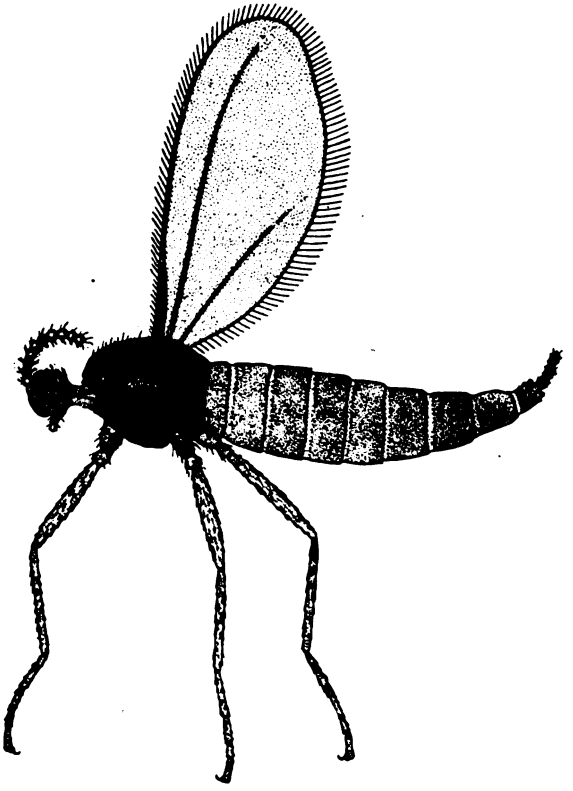


Fig. 60 Miastor americana, side view, enlarged. (Original)

decay from a variety of trees and proves to be rather common and widely distributed in New York State. The larvae of Oligarces ulmi Felt were found abundantly under the decaying bark of elm and numerous midges were reared. Leptosyna quercivora Felt was reared from partially rotten bark of red oak. Epimyia carolina Felt was taken in a woodland hut where there was an abundance of decaying vegetable matter in the vicinity. Two species of Brachyneura have been reared under conditions which

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lead us to believe that they may live in galls (possibly as inquilines). The larvae of certain species are extremely interesting biologically, since they reproduce by pedogenesis and are, moreover, very amenable to laboratory conditions.

Key to genera

a Metatarsus longer than the second segment
  b Tarsi quadriarticulate
    c Three long veins
      d Palpi quadriarticulate (amber).....Meunieria Kieff.[1]
      dd Palpi triarticulate.....Palaeospaniocera Meun.
      ddd Palpi biarticulate.....Miastor Mein.
    cc One long vein, wings very narrow.....Neostenoptera Meun.
  bb Tarsi triarticulate, 2 long veins
    c Antennal segments cylindric.....Heteropeza Winn.[2]
    cc Antennal segments globose (amber).....Monodicrana H. Lw.[1]
aa Metatarsus shorter than the 2d segment
  b Tarsi quinquearticulate
    c Wing membrane finely haired
      d Third vein extending to the apex of the wing
        e Palpi biarticulate.....Frirenia Kieff.
        f Fifth vein forked.....Haplusia Karsch
        ff Fifth vein simple.....Johnsonomyia Felt[3]
      cc Palpi triarticulate, wings acuminate.....Meinertomyia Felt
    eee Palpi uniarticulate, wings acute apically.....Leptosyna Kieff.
      dd Third vein not extending to the apex of the wing
        e Palpi biarticulate.....Frirenia Kieff.
        ee Palpi triarticulate.....Epimyia Felt
    cc Wing membrane scaled
      d Fifth vein forked, palpi quadriarticulate (amber).....
        Ledomyiella Meun.
      dd Fifth vein simple
        e Four simple long veins, palpi biarticulate, antennal segments stemmed in the female.....Kronomyia Felt
        ee Three simple long veins, palpi triarticulate.....
          Brachyneura Rond. (Spaniocera Winn.)
  bb Tarsi biarticulate.....Oligarces Mein.

[1] Location provisional.

[2] Messrs Kunstler and Chaine in Comptes Rendus Hebdomadaires des Séances et Mémoires de la Société de Biologie, 1902, v. 54, p. 535, give the characters of a form reared from bananas as follows: Tarsi biarticulate, the first segment longer than the second; wings with two or three long veins, the two first branched; palpi quadriarticulate. It was referred to the Heteropezinae, though no name was proposed and is presumably related to Heteropeza Winn. and Monodicrana H. Lw.

[3] The Australian Necrophlebia Skuse and Chastomera Skuse are apparently closely related to this American genus and are provisionally associated therewith.

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Meunieria Kieff.

1904 **Kieffer, J. J.** Soc. Sci. Brux. Ann., v. 28, pt. 2, separate, p. 42
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:36

This genus was erected by Kieffer for a species from amber designated by Meunier as *Miastor du succin*. It is separated from Miastor by the quadriarticulate palpi. No American forms are known.

Palaeospaniocera Meun.

1901 **Meunier, Fernand.** Soc. Sci. Brux. Ann., pt. 2, 25:191–92
1904 ———— Soc. Sci. Brux. Ann., 28, pt. 2, separate, p. 37
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:36

This genus was erected for an amber species, characterized by having 3 simple long veins, the tarsi quadriarticulate, the metatarsus being more than twice the length of the second segment, which latter is longer than the third and fourth combined. The antennae are composed of 13 cylindric segments, the thirteenth being plainly produced. The body is elongate, ovoid, the thorax slightly gibbous; palpi apparently composed of only 3 segments and the one lobe of the ovipositor plainly evident.

Miastor Mein.

1864 **Meinert, F. R.** Naturhist. Tidsskr., ser. 3, III, 42
1870 **Winnertz, Joh.** Vehr. z.-b. Ges. Wien, 20:5
1876 **Bergenstamm, J. E. & Löw, Paul.** Syn. Cecidomyidarum, p. 24
1877 **Karsch, F. A. F.** Revis. der Gallmucken, p. 15
1888 **Skuse, F. A. A.** Linn. Soc. N. S. Wales Proc., 3:58
1892 **Rubsaamen, E. H.** Berl. Ent. Zeit., 37:403
1894 **Kieffer, J. J.** Wien Ent. Zeit., 13:201
1898 ———— Syn. Cecid. Eur. & Alg., p. 54
1900 ———— Soc. Ent. Fr. Ann., 69:448
1904 **Meunier, F.** Soc. Sci. Brux. Ann., 28:9
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 316
1911 ———— N. Y. State Mus. Bul. 147, p. 84
1911 ———— N. Y. Ent. Soc. Jour., 19:36

Members of this genus have the wing membrane finely haired, the 3 long veins simple, the metatarsus quadriarticulate, the first segment being longer than the second. Palpi biarticulate. The generic type is M. metraloas Mein. The genus is probably worldwide or nearly so in its distribution.

Miastor americana Felt

1907 **Felt, E. P.** New Species of Cecidomyiidae II, p. 5
1908 ———— N. Y. State Mus. Bul. 124, p. 286
1909 ———— Ent. Soc. Ont. 39th Rep't, p. 44
1911 ———— Science, 33:302–3

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1911 ———— Can. Ent., 43:134–35; same in Science, 33:538; Econ. Ent. Jour., 3:296; Ent. News, 22:227; N. Y. Ent. Soc. Jour., 19:200–1
1911 ———— N. Y. State Mus. Bul. 147, p. 82–104
1911 ———— Econ. Ent. Jour., 4:414
1911 **Wheeler, W. M.** N. Y. Ent. Soc. Jour., 19:201

Prior to 1910 this species was known only through one female taken at Highland June 18, 1907. The interesting larvae of this remarkable form have subsequently been found in the decaying bark of maple, chestnut, oak, birch, beech and hickory at Highland, Tivoli, Nassau and Lake Placid, N. Y., indicating a considerable range for this species. The writer's experience justifies the belief that these insects are rather common under bark, in the incipient stages of decay. Miastor larvae have also been found in Connecticut and Indiana. A variable number of pedogenetic generations may occur in the fall and spring, the appearance of the adult midges being presaged by the development of a breastbone in the larvae, the formation of a prepupa and pupation. An extended discussion of pedogenesis as observed in this species, accompanied by descriptions of the larva and female, may be found in the writer's report for 1910. Stages not previously characterized are described below.

Prepupa. (Pl. 14, fig. 1) Length 1.75 mm. This stage is easily recognized by the apparent contraction and withdrawal of the body contents from the two extremities. The second to fifth segments become greatly enlarged, semitransparent, and on examination under a high power may be seen to contain the developing thoracic segments and their appendages. The head is much less prominent, being partially withdrawn into the anterior body segments. The well-developed breastbone is frequently visible, though occasionally obscured and is shed with the prepupal exuvium. The posterior extremity is also semitransparent and in the male distinctly bilobed.

Pupa. Length 1.5 mm; anterior extremity broadly rounded, semitransparent, the thoracic region somewhat larger, the thoracic horns long, slender, curved, the abdomen gradually tapering to a rather obtusely rounded, bilobed extremity. The posterior portion of the thoracic region and most of the abdomen whitish, the latter with a distinct orange tint in the subapical segment; terminal segment somewhat swollen, semitransparent, bilobed. Antennal, wing and leg cases semitransparent, the two latter extending to about the second abdominal segment and all, together with the eyes, gradually becoming infuscated till nearly black just prior to the appearance of the imago. The female pupa may have a length of 2 mm, the abdomen being longer, slender, and when viewed by transmitted light may show 4 or 5 large eggs.

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Exuvia. Whitish transparent, the dorsum of the abdominal segments with minute, chitinous points, the structures otherwise practically as in the pupa.

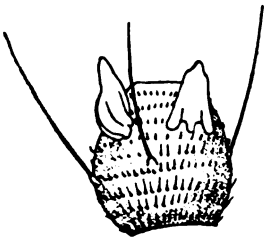


Fig. 61 Fifth antennal segment of Miastor americana, greatly enlarged. (Original)

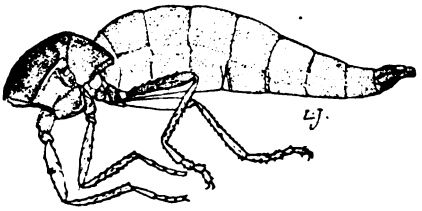


Fig. 62 Side view of thorax, legs and abdomen of Miastor americana. (Original)



Fig. 63 Palpus of Miastor americana, greatly enlarged. (Original)

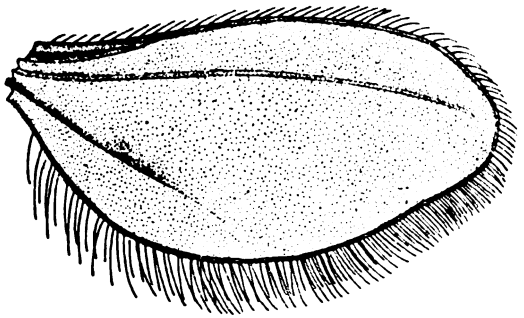


Fig. 64 Wing of Miastor americana, greatly enlarged. (Original)

Male. Length 1 mm. Antennae hardly extending to the base of the thorax, sparsely haired, yellowish or yellowish red; 11 segments, the fifth narrowly oval, with a length one-third greater than its diameter, a sparse whorl of stout setae near the middle and subapically a whorl of several irregular, narrowly triangular processes extending about to the basal fourth of the following segment; terminal segment oval, with a length one-third greater than its diameter. Palpi; first segment subquadrate, second segment oval, both sparsely setose. The vertex and eyes fuscous. Mesonotum yellowish brown. Scutellum brownish red, postscutellum reddish orange. Abdomen deep red; genitalia fuscous. Wings hyaline, costa yellowish basally, the distal half reddish; the feeble subcosta uniting with costa at the basal third, the third vein obsolescent

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distally, joining the margin at the apex of the wing; fifth vein simple, obsolete distally. Coxae, femora and tibiae fuscous yellowish, the tarsi tinged with red; claws rather long, evenly curved, simple, the pulvilli about half the length of the claws. Genitalia; basal clasp segment short, stout, obliquely truncate apically; terminal clasp segment short, stout, swollen subapically and with a heavy, chitinous spur at the internal distal angle; dorsal plate apparently short, triangularly emarginate, the lobes broadly rounded and sparsely setose; ventral plate apparently moderately long, stout, broadly rounded and sparsely setose apically; style short, stout, narrowly rounded distally.

Life history. Reproduction by pedogenesis occurs in the fall and early spring, and under certain conditions apparently throughout warm weather, though adults are usually produced from the latter part of May to August. Under favorable conditions it appears probable that pedogenesis may continue indefinitely. A larval generation occupies about 3 to 3½ weeks, much depending upon moisture, food and temperature. The transformations to the adult are preceded by the development of a distinct breastbone, this usually occurring in early May. The change is soon followed by the appearance of the prepupa, characterized by a marked swelling and transparent condition of the anterior body segments of the larva, and in 2 or 3 days by the development of the pupa, a stage lasting about 6 days. The small midges appear in immense numbers during the late morning hours, namely from about 9 a. m. until noon, swarming over the sides of the jar and behaving much like minute ants. There is comparatively little tendency to take wing. The development of adults may continue for several days and the midges may appear in smaller numbers for a period of several weeks. The large eggs, well formed in the abdomen of recently transformed females, are presumably deposited shortly and another succession of larval generations begun:

Natural enemies. Miastor is commonly preyed upon by the pinkish larvae of Lestodiplosis, and it is probable that Itonida pugionis Felt has similar habits. The larger predaceous maggots of Lonchaea polita Loew and a species of Medetrus were commonly found in the vicinity of Miastor colonies and were not infrequently the only available evidence of the earlier presence of midge larvae. Pseudotephritis vau Say was repeatedly reared from bark infested by Miastor larvae. In some instances the Pseudotephritis larvae occurred in clusters. These larvae may be predaceous enemies of the smaller Miastors.

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Neostenoptera Meun.

1901 **Meunier, Fernand.** Soc. Sci. Brux. Ann., pt. 2, 25:201 (Stenoptera)
1904 ———— Soc. Sci. Brux. Ann. 28, pt. 2, separate, p. 5
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:36

This genus was erected for a remarkable form found in copal from Africa. It is easily recognized by the extremely narrow, long-fringed wings having but one long vein, which latter unites with the anterior margin near the basal third. The tarsi are quadriarticulate, the metatarsus being nearly as long as the 3 following segments. The head is small, distinct, the palpi invisible. The antennae are apparently composed of 12 segments, the flagellate ones having an elongate, oval, basal enlargement ornamented near the middle with a closely set whorl of long, stout setae apparently resembling those of Johnsonomyia Felt. The stem of the fifth antennal segment is as long as the basal enlargement. Halteres very long. Type Stenoptera kiefferi Meun.

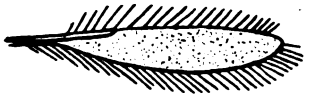


Fig. 65 Wing of Neostenoptera kiefferi, after Meunier

Heteropeza Winn.

1846 **Winnertz, J.** Stett. Ent. Zeit., 7:13–14
1870 ———— Vehr. z.-b. Ges. Wien, 20:4
1876 **Bergenstamm, J. E., & Löw, Paul.** Syn. Cecidomyidarum, p. 24
1877 **Karsch, F. A. F.** Revis. der Gallmucken, p. 16
1888 **Skuse, F. A. A.** Linn. Soc. N. S. Wales Proc., 3:57
1892 **Rubsaamen, E. H.** Berl. Ent. Zeit., 37:401
1894 **Kieffer, J. J.** Wien Ent. Zeit., 13:201
1898 ———— Syn. Cecid. Eur. & Alg., p. 54
1900 ———— Soc. Ent. Fr. Ann., 69:444
1904 **Meunier, F.** Soc. Sci. Brux. Ann., 28:9
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:36
1911 ———— N. Y. State Mus. Bul. 147, p. 84

This genus may be recognized by the 2 simple long veins of the wings terminating at the basal third of the anterior and posterior margins respectively (the wing tip is narrowly rounded, hardly acute); the 3 tarsal segments, the first being the longest, and the 4 palpal segments. Antennal segments in the female 10, sessile, cylindric, and with a length three-fourths the diameter, thickly haired; in the male 11, stemmed; ocelli absent. Ovipositor one-fourth the length of the abdomen, somewhat thickened, the lobes slender, setose. Type H. pygmaea Winn.

Only two species are known, the European H. pygmaea having been reared from the bark of rotting trees, and H. transmarina Schin. recorded as bred from small excrescences on the leaves of Callistemon.

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Monodicrana H. Lw.

1850 **Loew, H.** Dipt. Beitr., 4:11–12
1900 **Kieffer, J. J.** Ent. Soc. Fr. Ann., 69:444
1904 **Meunier, Fernand.** Soc. Sci. Brux. Ann., 28, separate, p. 9, 33
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:36

This amber species has been doubtfully referred to the Itonididae, apparently being most closely allied to Heteropeza. Kieffer states that this species has a length of 1.1 mm, the borders of the wings being ciliate and the membrane not hairy; that the moniliform antennae have the funicle composed of 8 globose segments and an oval terminal segment. The tarsi are quadriarticulate. The type is M. terminalis H. Lw.

Haplusia Karsch

1877 **Karsch, F. A. F.** Revis. de Gallmucken, p. 15
1892 **Rubsaamen, E. H.** Berl. Ent. Zeitschr., 37:328, 368–69
1896 **Kieffer, J. J.** Wien. Ent. Zeit., 15:91
1900 ———— Soc. Ent. Fr. Ann., 69:448
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:37
1911 ———— N. Y. State Mus. Bul. 147, p. 84

This genus was erected for a unique female having at least 11 and possibly 14 antennal segments, the fifth with a stem three-fourths the length of the cylindric basal enlargement, which latter has a length three times its diameter and has a short, rather thick basal, and a thick extended distal whorl of long, curved setae; circumfili absent. The palpi are quadriarticulate. The wings have 3 long veins; subcosta with a rudimentary vein at the basal fourth somewhat as in Diallactes. A rudimentary crossvein appears to unite its distal third to the third vein, the latter joining the wing margin probably well beyond the apex. The fifth unites with the margin at the distal third, its branch apparently at the basal half. The fork is therefore very short. The first tarsal segment is short, while the fifth tapers to the small, simple claws with rudimentary pulvilli. The ovipositor is rather short, triarticulate, the terminal segment slender, tapering and sparsely setose.

The above characters are drafted from the type species, H. plumipes Karsch, now in the Berlin Museum of Natural History and very nicely mounted in balsam, thanks to the skill of Professor Rubsaamen. We agree with him in referring this form to the Heteropezinae.

Tetradiplosis Kieff. & Jörg.

1910 **Kieffer, J. J. & Jörgensen, P.** Centrbl. Bakt. Parsit. Insektk., 27:421–23
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:37

This Argentine genus is tentatively referred to the Heteropezinae because of the total absence of circumfili. It appears to be allied

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to the South American Haplusia Karsch from which it is easily separated by the unidentate claws.

Antennae with 14 segments, the cylindric fifth with a length about twice its diameter and a stem not longer than wide. Palpi quadriarticulate, the segments short. Wings long; the supernumerary vein extends beyond the middle of subcosta, which latter unites with costa at the middle of the wing. There appears to be a distinct crossvein, the third vein joining the margin beyond the apex of the wing. Tarsi quinquearticulate; claws fuscous, toothed, the two portions nearly equal and strongly bent; pulvilli wanting. Ovipositor not produced, with 2 gradually tapering lamellae, each about three times as long as broad. The larva is remarkable because of the 6 small, triangular teeth internally on the diverging subtriangular major lobes of the breastbone; shaft well developed. Reared from a stem gall on Prosopis alpataco. Type T. sexdentatus Kieff. & Jörg.

Johnsonomyia Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 417
1911 ———— N. Y. Ent. Soc. Jour., 19:37
1911 ———— N. Y. State Mus. Bul. 147, p. 84

This genus was erected for several small forms apparently allied to Colpodia Winn. A closer study of the species, however, shows that circumfili are absent and compels us to refer this genus to the Heteropezinae. The short first tarsal segment, the antennal and alar structures indicate a relationship to Haplusia Karsch, from which it is easily separated by the simple fifth vein. This is a remarkable synthetic form, since the arrangement of the long setae on the antennal segments closely approximate that of the peculiar crenulate whorls in Campylomyza, while the venation alone would lead one to refer it at once to the Epidosariae. Type J. rubra Felt.

This genus appears to be related to the Australian Chastomera Skuse, though the latter is remarkable because of the third vein being widely distant from subcosta.

Key to species

a Abdomen reddish brown, length 4 mm, the fifth antennal segment with a stem one-half longer than the basal enlargement..... rubra Felt, C. 826

aa Abdomen dark brown and yellowish, length 4 mm, the fifth antennal segment with a stem as long as the basal enlargement..... fusca Felt, C. 1237

aaa Abdomen reddish yellow, wings indistinctly banded, length 5 mm, the fifth antennal segment with a length three-fourths the basal enlargement.....cincta Felt

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Johnsonomyia rubra Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 417

This interesting form and type of the genus was taken at Montpelier, Vt., June 26, 1906 by Prof. C. W. Johnson.

Male. Length 4 mm. Antennae as long as the body, thickly long haired, dark brown; 16 segments, the fifth with a stem one-half longer than the subcylindric basal enlargement, which latter has a length twice its diameter, a subbasal whorl of short, stout, slightly curved setae, near the basal third a thick whorl of closely set, long, strongly curved setae arising from conspicuous tubercles; subapically there is a scattering whorl of similar long setae; terminal segment with the basal portion slightly produced, the stem much reduced, rudimentary. Palpi; the first segment short, stout, subquadrate, the second fully twice the length of the first, expanding distally, the third a little stouter, about as long as the second, the fourth shorter and more slender than the third, the fifth nearly twice the length of the fourth, all sparsely clothed with coarse setae; face fuscous yellowish, eyes rather large, black. Mesonotum dark reddish brown. Scutellum fuscous yellowish, postscutellum a little darker. Abdomen rather thickly clothed with yellowish hairs, reddish brown. Genitalia fuscous yellowish. Wings hyaline, costa reddish brown. Halteres yellowish basally, fuscous apically. Legs a fuscous yellowish, the distal three tarsal segments yellowish white; claws probably simple. Genitalia; basal clasp segment short, stout, slightly rounded externally, somewhat excavated internally, nearly truncate distally; terminal clasp segment very short, stout, greatly swollen basally and tapering distally to a conspicuous, prolonged, denticulate, chitinous process. (See plate 11, figure 6.) Type Cecid. 826.

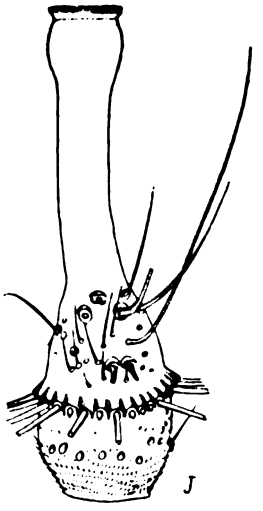


Fig. 66 Fifth antennal segment of Johnsonomyia rubra, enlarged. (Original)

Johnsonomyia fusca Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 417

This species was taken at Albany, N. Y., August 9, 1907.

Male. Length 4 mm. Antennae nearly as long as the body, sparsely haired, fuscous yellowish; 16 segments, the fifth with a stem as long as the suboval basal enlargement, which latter has a length about twice its diameter, with a conspicuous whorl of long,

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stout setae near the middle and numerous setae of variable length clothing the face of the enlargement; terminal segment produced, with a length about five times its diameter and at the distal fourth

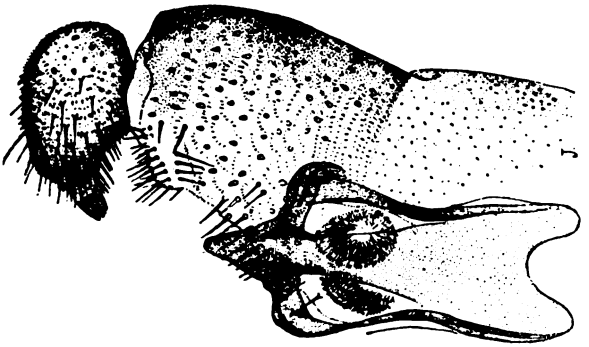


Fig. 67 Portion of male genitalia of Johnsonomyia rubra, enlarged. (Original)

a distinct constriction. Palpi; first segment stout, incrassate, with a length three times its diameter, the second as long as the first, rectangular, the third a little shorter than the second, the fourth slender, with a length more than twice the third. Mesonotum shining brown, the submedian lines rather thickly haired. Scutellum dark brown, postscutellum yellowish brown. Abdomen a variable dark brown and yellowish brown, the dorsum of the first segment and that of the fourth to eighth fuscous yellowish; genitalia fuscous. Wings hyaline, costa dark brown, venation practically as in J. rubra, though the wing is markedly smaller. Halteres yellowish, fuscous subapically; pleurae and coxae a variable fuscous yellowish; femora, tibiae and the 2 basal tarsal segments a dark fuscous yellowish, almost black, the tip of the second tarsal segment, the third and fourth white, the fifth yellow tinted apically; claws rather long, stout, slightly curved, simple, pulvilli rudimentary. Genitalia; basal clasp segment short, stout; terminal clasp segment very short, greatly swollen and with a long, chitinous tooth apically. (Plate 11, figure 7.) Type Cecid. 1237.

Johnsonomyia cincta Felt

1912 **Felt, E. P.** N. Y. Ent. Soc. Jour., 20:103

A large, strikingly colored midge taken on the Polochic river, Guatemala, February 22, 1912, by Messrs Barber and Schwarz.

Chastomera Skuse

1888 **Skuse, F. A. A.** Linn. Soc. N. S. Wales Proc., 3:112
1892 **Rubsaamen, E. H.** Berl. Ent. Zeitschr., 37:333
1900 **Kieffer, J. J.** Soc. Ent. Fr. Ann., 69:448
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:37

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This Australian genus was erected for the reception of a female having 16 stemmed antennal segments and 4 palpal segments. Like Haplusia, the third vein unites with the margin well beyond the apex and is joined to subcosta by a long distinct crossvein; the fifth vein is simple, uniting with the posterior margin near the basal half. The type species, C. b e l l a Skuse, is characterized as having almost pyriform flagellar segments, the stem being nearly as long as the basal enlargement, the latter with numerous whorls of hairs, the basal whorl much longer than the rest.

Necrophlebia Skuse

1888 **Skuse, F. A. A.** Linn. Soc. N. S. Wales Proc. S. 2, 3:111, pl. 2, fig. 10
1892 **Rubsaamen, E. H.** Berl. Ent. Zeitschr., 37:332 (quotes Skuse)
1900 **Kieffer, J. J.** Ent. Soc. Fr. Ann., 69:449 (quotes Skuse)
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:37

The female of this Australian genus has the antennae about half the length of the body. There are 14 segments, each with a stem one-half the length of the subcylindric basal enlargement, which latter has 2 sparse whorls of hairs. Palpi quadriarticulate. The illustration shows the wing to be rather broad, subcosta uniting with costa well before the basal half, a distinct, somewhat oblique crossvein, the third a little beyond the apex, while the simple fifth joins the posterior margin near the basal half. This genus appears to be closely related to Johnsonomyia Felt. The 2 genera agree in major characters and it is possible that further study may prove our American forms cogeneric with this Australian species. Type N. v o l i t a n s Skuse.

Meinertomyia Felt

1870 **Meinert, F. R.** Naturhist. Tidsskr., ser. 3., 6:463 (Pero)
1876 **Bergenstamm, J. E. & Löw, Paul.** Syn. Cecidomyidarum, p. 24 (Pero)
1877 **Karsch, F. A. F.** Revis. der Gallmucken, p. 15 (Pero)
1892 **Rubsaamen, E. H.** Berl. Ent. Zeit., 37:328, 369 (Pero)
1894 **Kieffer, J. J.** Wien. Ent. Zeit., 13:201 (Pero)
1898 ———— Synop. Cecid. Eur. & Alg., p. 54 (Pero)
1900 ———— Soc. Ent. Fr. Ann., 69:448 (Pero)
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:37
1911 ———— N. Y. State Mus. Bul. 147, p. 85

This genus may be recognized by the 3 long veins and the finely haired membrane of the acuminate wings, in connection with the 5 tarsal segments, the metatarsus being shorter than the preceding. It is separated from Leptosyna Kieff. by the triarticulate palpi. Pero Mein. is preoccupied by Pero H. Schf.

Type and sole species P e r o f a s c i a t a Mein., the larvae of which occur under the bark of hornbeam and reproduce by pedogenesis. European.

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Leptosyna Kieff.

1894 **Kieffer, J. J.** Wien. Ent. Zeit., 13:201, 209–11
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:37
1911 ———— N. Y. State Mus. Bul. 147, p. 85

This genus has 3 simple long veins, the third attaining the tip of the wing, the wing membrane finely haired, tarsi, quinquearticulate, the metatarsus shorter than the second segment. It may be separated from Meinertomyia Felt by the uniarticulate palpi. Antennal segments in the female 12, in the male 13. Type L. acutipennis Kieff.

Leptosyna quercivora Felt

1911 **Felt, E. P.** Econ. Ent. Jour., 4:546 (L. quercus)
1912 ———— N. Y. State Mus. Bul. 155, p. 123 (new name)
1913 **Kieffer, J. J.** Marcellia, 11:235 (L. quercicola)

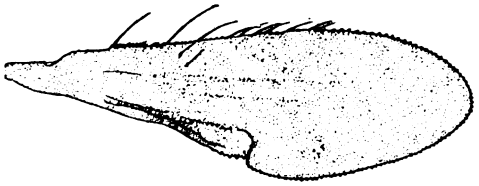


Fig. 68 Wing of Leptosyna quercivora, enlarged. (Original)

This slender, yellowish midge was reared April 20, 1911 from partially rotten bark of red oak, Quercus rubra, collected at Nassau, N. Y., the preceding fall on account of its being infested

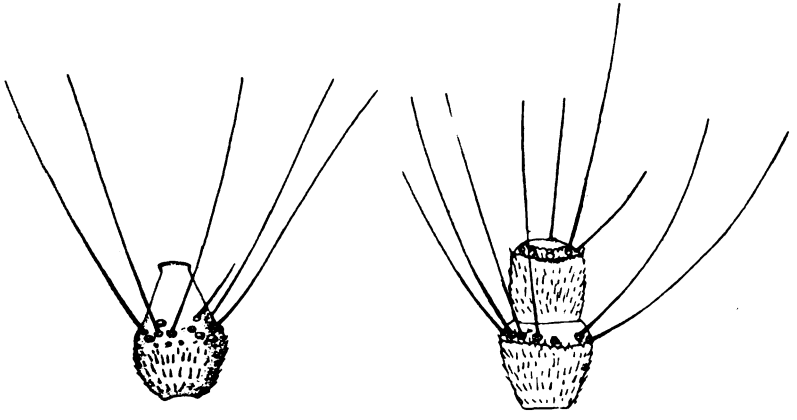


Fig. 69 Seventh and distal two antennal segments of Leptosyna quercivora, enlarged. (Original)

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with yellowish Sciara larvae. The larva of this midge was not seen. This species is closely allied to L. a m e r i c a n a from which it is most easily separated by the relatively longer twelfth and thirteenth antennal segments, these latter having a length two and one-half times the diameter, the distal being knobbed. See the above citation for a description of the male.

Leptosyna americana n. sp.

The specimen referred to this genus was captured in a trap lantern at Nassau, N. Y., May 27, 1908.

Male. Length .75 mm. Antennae extending to the second abdominal segment, sparsely haired, fuscous yellowish; 13 segments, the first somewhat produced, obconic, the second short, subglobose, the third and fourth distinct, the fifth with a stem as long as the subcylindric basal enlargement, which latter has a length one-half greater than its diameter and is adorned subapically with a thick whorl of long, stout setae, the twelfth and thirteenth segments are rather closely fused, the latter truncate apically. Palpi apparently uniarticulate. Mesonotum dark reddish brown. Scutellum, postscutellum and abdomen fuscous yellowish or yellowish orange. Wings hyaline, subcosta uniting with costa at the basal third, the third vein at the apex and the simple fifth at the distal third. Halteres yellowish transparent. Legs light fuscous yellowish; tarsi slightly darker, presumably five-segmented. Genitalia; basal clasp segment stout, truncate; terminal clasp segment stout, strongly curved, apically with a heavy, recurved, process; dorsal plate long, broad, deeply and triangularly emarginate, the lobes roundly truncate; ventral plate long, nearly divided, the lobes long, slender, tapering, narrowly rounded. (Plate 13, figure 5.) Type Cecid. 1341.

Frirenia Kieff.

1894 **Kieffer, J. J.** Wien. Ent. Zeit., 13:204, 206–9
1904 **Meunier, F.** Soc. Sci. Brux. Ann., 28:9
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:37
1911 ———— N. Y. State Mus. Bul. 147, p. 85

Members of this genus may be recognized by the 3 simple long veins, the third disappearing before the tip of the wing, the membrane sparsely clothed with fine hairs, and the 5 tarsal segments, the first being shorter than the second, in connection with the biarticulate palpi. Antennal segments 13, subcylindric and with short stems in both sexes. Male genitalia; basal clasp segment stout, subtriangular; terminal clasp segment rather long, stout, with a distinct, chitinous process at the internal distal angle; dorsal plate short, broad, deeply and roundly emarginate, the lobes roundly triangular; ventral plate rather long, broad, truncate apically; ovipositor short, the lobes consisting of three subequal segments. Type F. t e n e l l a Kieff. No American species are known.

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Epimyia Felt

1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:38
1911 ———— N. Y. State Mus. Bul. 147, p. 85

This genus is erected for a remarkable species evidently somewhat allied to Frirenia Kieff. The third vein unites with the anterior margin near the distal fourth, while the simple fifth joins the posterior margin at the basal half. Palpi triarticulate, the claws simple

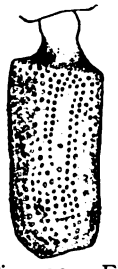


Fig. 70 Fifth antennal segment of Epimyia carolina, enlarged. (Original)

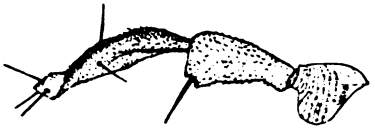


Fig. 71 Palpus of Epimyia carolina, enlarged. (Original)

and the genitalia of the male remarkably complex. The abundant vestiture and neuration of the wing indicate a relationship to Brachyneura Rond. though the absence of the characteristic scales on the membrane and the peculiar genitalia show that it has little in common with Brachyneura vitis Felt. The female is unknown. Type and sole species Epimyia carolina Felt.

Epimyia carolina Felt

1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:38

The single specimen known was taken on the window of a woodland hut at Davidson's River, N. C., September 23, 1906.

Ledomyiella Meun.

1904 **Meunier, Fernand.** Soc. Sci. Brux. Ann., v. 28, pt. 2, p. 33
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:38

This genus appears to be a rather common form in amber. It may be separated from Brachyneura Rond. by the metatarsus being shorter than the second segment and by the fork of the fifth long

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vein. Tarsal segments five. Antennal segments 14, cylindric, sessile in the female, stemmed in the male; palpi quadriarticulate, the venation about as in Brachyneura aside from the forked fifth vein noted above. Type L. s u c c i n i Meun. No American species are known.

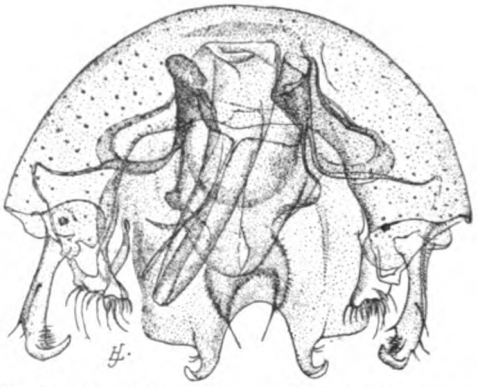


Fig. 72 Male genitalia of E p i m y i a c a r o l i n a, enlarged. (Original)

Kronomyia Felt

1911 **Felt, E. P.** Econ. Ent. Jour., 4:476

The unique form noticed below is evidently allied to Brachyneura Rond., though readily separated therefrom by the 4 long veins, the fifth and sixth being simple, and the totally different an-

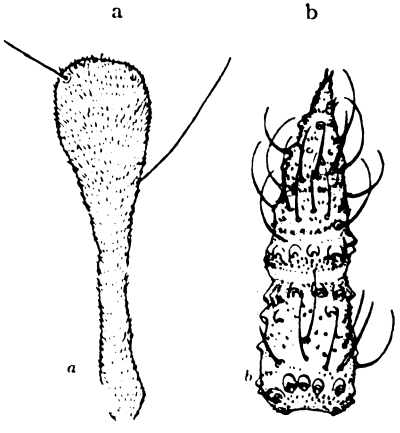


Fig. 73 *a* Palpus; *b* distal antennal segment of K r o n o m y i a p o p u l i, enlarged. (Original)



Fig 74 Claw of K r o n o m y i a p o p u l i, enlarged. (Original)

tennal structure. The antennae in the female of this species have but 12 segments, the apical evidently composed of 2 closely fused

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reduced segments, the other flagellate ones with a short stem and a short, stout basal enlargement ornamented with a basal whorl of long, stout setae and a thick band of short, curved setae. The biarticulate palpi with the greatly produced, capitate terminal segment and the peculiar ovipositor, all serve to differentiate this species from allied genera. Type K. p o p u l i n. sp.

Kronomyia populi Felt

1911 **Felt, E. P.** Econ. Ent. Jour., 4:476–77

This peculiar form was reared May 5, 1911 from a whitish larva found in punky poplar wood at Nassau, N. Y., April 12, 1911. Only one larva was observed and this presented the general appearance of a small Oligarces larva just after it had escaped from the mother larva in early spring. See the above citation for a description of the female; also plate 13, figure 6.

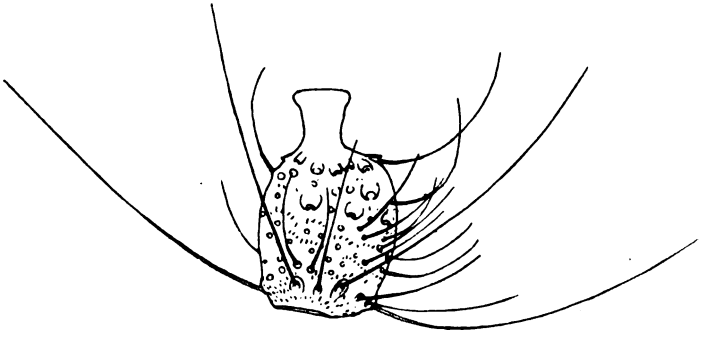


Fig. 75 Fifth antennal segment of K r o n o m y i a p o p u l i, enlarged. (Original)

Brachyneura Rond.

1846 **Rondani, Camillo.** Nouvi Ann. Sc. Nat. Bolog., ser. 2, VI; separate, p. 13
1853 **Winnertz, J.** Linn. Ent., 8:190 (Spaniocera)
1862 **Osten Sacken, C. R.** Dipt. N. Am., 1:175
1876 **Bergenstamm, J. E., & Löw, Paul.** Syn. Cecidomyidarum, p. 24
1877 **Karsch, A. F. A.** Revis. der Gallmucken, p. 15
1888 **Skuse, F. A. A.** Linn. Soc. N. S. Wales Proc., 3:42, 146
1892 **Rubsaamen, E. H.** Berl. Ent. Zeit., 37:401–?366?
1894 **Kieffer, J. J.** Wien. Ent. Zeit., 13:201
1898 ———— Syn. Cecid. Eur. & Alg., p. 55
1900 ———— Soc. Ent. Fr. Ann., 69:439, 447
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 316, 317
1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:38
1911 ———— N. Y. State Mus. Bul. 147, p. 85

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Members of this genus are easily recognized by their general resemblance to Lasioptera in connection with the densely scaled, usually fuscous wing membrane. The two are readily separated by the fact that the antennal segments in Brachyneura are much longer than in Lasioptera and, moreover, never possess the characteristic circumfili almost invariably found in the Itonididinae. The antennae are composed of 12 segments. There are 3 simple long veins. The tarsi are quinqearticulate. Type B. fusco-grisea Rond.

Two American species of this genus have been reared, one B. eupatorii was bred presumably from an oval swelling on thoroughwort, Eupatorium perfoliatum, the other species, B. vitis, was reared from a jar containing the familiar Lasioptera vitis gall on grape, Vitis sp., and presumably came from this plant.

Key to species

a Fifth antennal segment with a length twice its diameter; scutellum yellowish

b Antennae with 11 segments, femora and tibiae dark brown. Bred ? from Lasioptera vitis gall.....vitis Felt, C. a1165d

bb Antennae with 12 segments; femora and tibiae silvery grey. Bred from thoroughwort, Eupatorium perfoliatum.....eupatorii Felt, C. a1349

aa Fifth antennal segment with a length three times its diameter, scutellum black, legs uniform fuscous or black..americana Felt, C. 734

Brachyneura vitis Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 317
1909 ———— Ent. Soc. Ont. 39th Rep't, p. 44

This species was reared July 13, 1907 from a jar containing the familiar Lasioptera vitis galls on grape, Vitis sp., and presumably came from this plant.

Male. Length .5 mm. Antennae nearly as long as the body, sparsely haired, dark brown; 11 segments, fifth subcylindric, with a stem one-fourth the basal enlargement, which latter has a length about twice its diameter, and is thickly clothed with short, narrow, appressed scales; terminal segment produced, tapering to a narrowly rounded apex. Palpi; the first segment short, stout, subquadrate, the second and third apparently stout, each with a length about three times its diameter. Mesonotum black. Scutellum, postscutellum and basal abdominal segment apparently fuscous yellowish, the remainder of the abdomen dark brown, sparsely haired. Wings hyaline, costa dark brown; membrane thickly clothed with fine hairs. Halteres yellowish transparent. Legs a variable dark brown; claws unidentate, pulvilli shorter than the claws. Genitalia;

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basal clasp segment long, slender, roundly truncate; terminal clasp segment short, swollen basally; dorsal plate long, broad, deeply and triangularly emarginate; ventral plate long, narrow, deeply and broadly emarginate; style stout, nearly uniform. Type Cecid. a1165d.



Fig 76 Fifth antennal segment of Brachyneura vitis, enlarged. (Original)

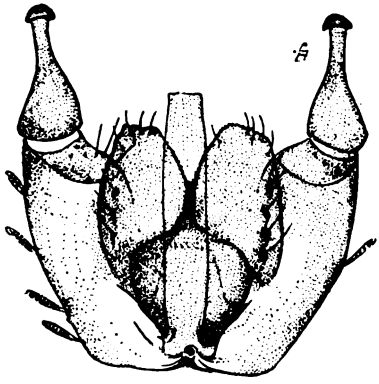


Fig. 77 Male genitalia of Brachyneura vitis, enlarged. (Original)

Brachyneura eupatorii Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 317
1909 ———— Ent. Soc. Ont. 39th Rep't, p. 44

The female was reared September 14, 1907, possibly from a gall on thoroughwort, Eupatorium perfoliatum, taken at Poughkeepsie, N. Y. The swelling on the stem was about 6 mm in diameter and contained 6 yellow larvae occupying cocoons massed in the center of the cell.

Female. Length 1.2 mm. Antennae shorter than the body, densely clothed with scales, presumably dark brown, the basal segments creamy white; 12 segments, the fifth with a length about twice its diameter; terminal segment slightly produced, with a length three times its diameter and apically with a short, stout, knoblike appendage. Palpi; the first segment short, stout, irregular, the second subrectangular, with a length about three times its diameter, slightly expanded distally, the third as long as the second, slender, tapering at both extremities. Face creamy white, eyes large, black, with fine, white points. Mesonotum dark fuscous, the submedian lines narrowly whitish. Scutellum yellowish, clothed with silvery hairs. Abdomen black, except where the whitish ground color appears; membrane and pleurae pale yellowish, ovipositor whitish apically. Wings black, costa black, thickly clothed with scales. Halteres black, whitish at the base, the pedicel unusually short and curved. Coxae pale yellowish; femora and tibiae

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silvery gray, the posterior tarsi silvery gray, the 2 distal segments black, the anterior and mid tarsi darker; claws unidentate, pulvilli shorter than the claws. Ovipositor short, the terminal lobes broadly oval. Type Cecid. a1349.

Brachyneura americana Felt

1907 **Felt, E. P.** New Species of Cecidomyiidae II, p. 5
1908 ———— N. Y. State Mus. Bul. 124, p. 286

The single female representing this species was taken August 2, 1906 on the office window in Albany, N. Y., and was presumably reared from material brought into the office.

Female. Length 1 mm. Antennae extending to the base of the abdomen, thickly clothed with narrow scales, black; 12 segments, the fifth subcylindric, the enlargement, with a length nearly three times its diameter; terminal segment produced, slender, distally tapering to a narrowly rounded apex. Palpi; the first segment short, stout, somewhat rounded, the second more than twice the length of the first, more slender, the third a little longer and more slender than the second. Mesonotum very dark brown, sparsely ornamented with yellowish hairs. Scutellum black with yellowish hairs basally, postscutellum and abdomen dark brownish black. Wings subhyaline, the membrane thickly clothed with narrow fuscous scales, costa black. Halteres fuscous yellowish basally, black apically. Legs mostly a uniform fuscous or black, the second and third segments of the posterior tarsi fuscous yellowish; claws long, unidentate, the pulvilli as long as the claws. Ovipositor short, the lobes short, narrowly rounded. Type Cecid. 734.

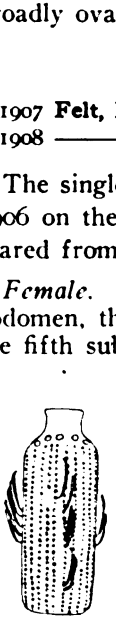


Fig. 78 Fifth antennal segment of Brachyneura americana, enlarged. (Original)

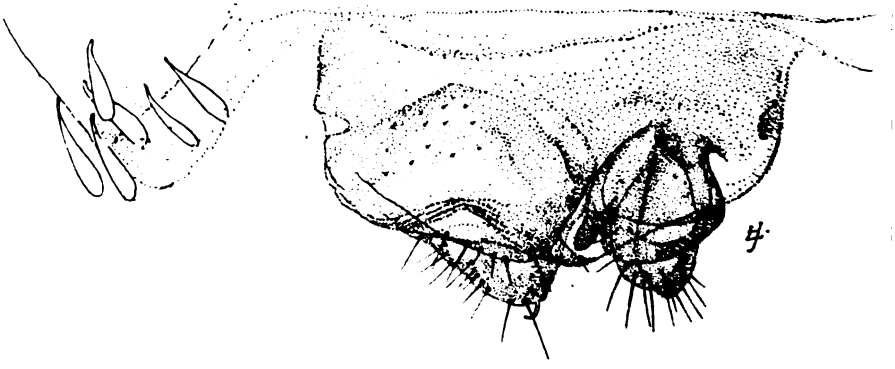


Fig. 79 Ovipositor of Brachyneura americana, enlarged. (Original)

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Oligarces Mein.

1865 **Meinert, F. R.** Naturhist, Tidsskr., ser. 3, III, 238
1876 **Bergenstamm, J. E., & Löw, Paul.** Syn. Cecidomyidarum, p. 24
1877 **Karsch, F. A. F.** Revis. der Gallmucken, p. 16
1892 **Rubsaamen, E. H.** Berl. Ent. Zeit., 37:401.
1894 **Kieffer, J. J.** Wien. Ent. Zeit., 13:201
1898 ———— Syn. Cecid. Eur. & Alg., p. 53
1900 ———— Soc. Ent. Fr. Ann., 69:448
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124, p. 317
1911 ———— N. Y. Ent. Soc. Jour., 19:38
1911 ———— N. Y. State Mus. Bul. 147, p. 85

This genus was erected by Meinert in 1865 with O. paradoxus as the type and sole species. Members of this genus may be recognized by the finely haired wing membrane and the 2 or 3 simple veins in connection with the biarticulate tarsi, the first segment being shorter than the second. The mouth parts are rudimentary or wanting.

Oligarces noveboracensis Felt

1907 **Felt, E. P.** New Species of Cecidomyiidae II, p. 5
1908 ———— N. Y. State Mus. Bul. 124, p. 286

This species was taken on a window at Albany, N. Y., July 15, 1907 and was presumably reared from material brought into the office.

Female. Length 1 mm. Antennae extending to the second abdominal segment, pale yellowish; 13 segments, the fifth and following sessile, cylindric, with a length about one-fourth greater than the diameter; terminal segment reduced, narrowly rounded apically and irregularly clothed with long, chitinous spines. Palpi apparently wanting, eyes small, brown, ocelli absent; face yellowish. Mesonotum light brown, pleurae pale orange. Scutellum and postscutellum light fuscous yellowish. Abdomen pale yellowish, the basal and distal segments pale orange, the ovipositor pale white. Wings long, narrow, hyaline, costa pale yellowish, subcosta uniting with the anterior margin at the basal third, the third vein near the basal half, the fifth indistinct distally, joining the posterior margin at the basal half, its branch at the basal fourth, entire margin thickly clothed with long, rather stout hairs. Halteres yellowish transparent. Legs pale yellowish white. Coxae short, irregular; femora long, stout, fusiform, tibiae a little longer, with weak spines apically, tarsi biarticulate, the first segment about three-fourths the length of the slender second. Claws short, stout, slightly curved; pulvilli rudimentary; venter of eighth abdominal segment with submedian, subquadrate appendages. Ovipositor short, indistinctly triarticulate, the third segment long, narrowly oval. Type Cecid. 1226.

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Oligarces ulmi Felt

1911 **Felt, E. P.** Econ. Ent. Jour., 4:477-78

The larvae of this species were found at Nassau, N. Y., March 18, 1911 in the thick, partly decaying bark of an old elm, Ulmus, cut some two or three years ago. They were so inconspicuous and concealed in the tissues that there was some doubt for a time as to there being anything living in the bark, though one or two exuviae led us to believe that larvae might be present. The infested bark was brought into a warm room March 20th and on the 22d a number of whitish transparent young appeared. By the 27th there were literally thousands upon the inside of the breeding jars, crawling freely upon the glass. Many perished while others doubtless reestablished themselves in the bark. These larvae do not appear very amenable to laboratory methods, since we were unable to obtain adults from a small piece of bark containing hundreds of larvae clamped to a microscopic slide and kept in a small box. The few placed in water under a cover-glass soon escaped.

The first pupa was observed April 18. When discovered it was standing at an oblique angle, being supported by the presumably glutinous posterior extremity, since at this stage there are no clasping organs. The pupa soon turned and twisted, released its hold and was shortly lying at a totally different angle upon the moist surface of the wood. The pupal period probably extends over two or three days. The pupae evidently work themselves partly out of the wood before disclosing the adult. The first imagoes were found April 24th, females occurring in increasing numbers until about the 26th, at which time males became very numerous and continued so to the 29th. The adult flies emerge almost entirely between 10 a. m. and noon. They display a marked preference for the light, crawl freely, and when abundant run about in much the same manner as a swarm of winged ants. They crawl easily upon the surface of a glass cage though they frequently drop. Very little can be seen of the midges except at the hours above named, even when they are allowed to remain in the cage from day to day. It is probable that the eggs are deposited shortly after the females emerge. An individual may contain one to four ova, each with a length about three-fourths that of the abdomen. One female dropped in alcohol extruded two eggs which remained attached to the extremity of the abdomen (plate 14, figure 4).

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The colony we discovered was practically free from natural enemies, since only one Lestodiplosis larva was observed in the material collected and no adults reared.

Egg. Length .4 mm, diameter .08 mm, extremities rounded. The egg is white and granular.

Mother larva. Length 2.5 mm, moderately stout, tapering toward each extremity, a dull yellowish white, the color harmonizing so closely with the decaying inner bark of elm as to be detected with difficulty. Head rather short, broad; the antennae short, stout, uniarticulate; transverse bands of spines on the distinct body segments rudimentary or wanting, the margins of the incisures of both extremities frequently rather strongly chitinized; the posterior extremity is rather stout, bilobed, the lobes rather broadly and irregularly rounded and with minute tubercles; the skin is nearly smooth. An overwintering mother larva may contain 8 or 10 practically fully developed young.

Young larva. Length 1.5 mm, moderately stout, white or whitish transparent, the posterior extremity sometimes with a darker reflection, due possibly to the black bark upon which the specimen was resting. Head long, triangular, the anterior third rather heavily chitinized, except the extreme apex; antennae moderately long, tapering, biarticulate; skin nearly smooth, transverse bands of spines, rudimentary or wanting; posterior extremity obtuse, bilobed, the lobes irregularly rounded and minutely tuberculate.

Pupa. Length 1 mm, moderately stout, eyes reddish brown, the thorax pale yellowish; abdomen yellowish orange; thoracic horns long, slender; antennal cases stout, extending to the base of the wing pads, the wing and leg cases extending to about the third abdominal segment; abdomen smooth, the fourth to ninth segments free and successively tapering, flexible; the posterior extremity broadly rounded and in the male, slightly bilobed. At the humeral angles there is a pair of irregularly oval, fuscous or reddish brown spots.

Exuviae. Whitish transparent, the dorsum of the abdominal segments with irregular rows of minute, chitinous points.

Female. Length 1.2 mm. Antennae short, very sparsely haired, brownish yellow; 10–12 subsessile segments, the fifth with a length about one-fourth greater than its diameter, broadly pyriform, with a few long, stout setae subbasally and an irregular whorl of long, chitinous spines subapically; terminal segment reduced, narrowly oval. Palpi apparently wanting. Face fuscous yellowish; eyes light brown. Mesonotum dark brown, the submedian lines fuscous yellowish. Scutellum reddish brown, postscutellum and abdomen pale yellowish or reddish orange, frequently slightly fuscous apically, the ovipositor fuscous yellowish. Wings long, narrow; fringe long. Halteres yellowish transparent. Legs a somewhat variable reddish yellow, the tarsi somewhat darker; first tarsal

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segment with a length about one-third that of tibia, the second tarsal segment with a length one-fourth greater than the first; claws stout, slightly curved, the pulvilli rudimentary. Abdomen slender and containing one to three large eggs, each with a length about three-fourths that of the abdomen; the eighth segment ventrally with submedian, irregularly pyriform appendages. Ovipositor short, indistinctly triarticulate, the third segment with a length two and one-half times its diameter. For a description of the male, see the above citation. Type Cecid. a2136.

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EXPLANATION OF PLATES

PLATE 1

[227]

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Pear thrips

Euthrips pyri Daniel

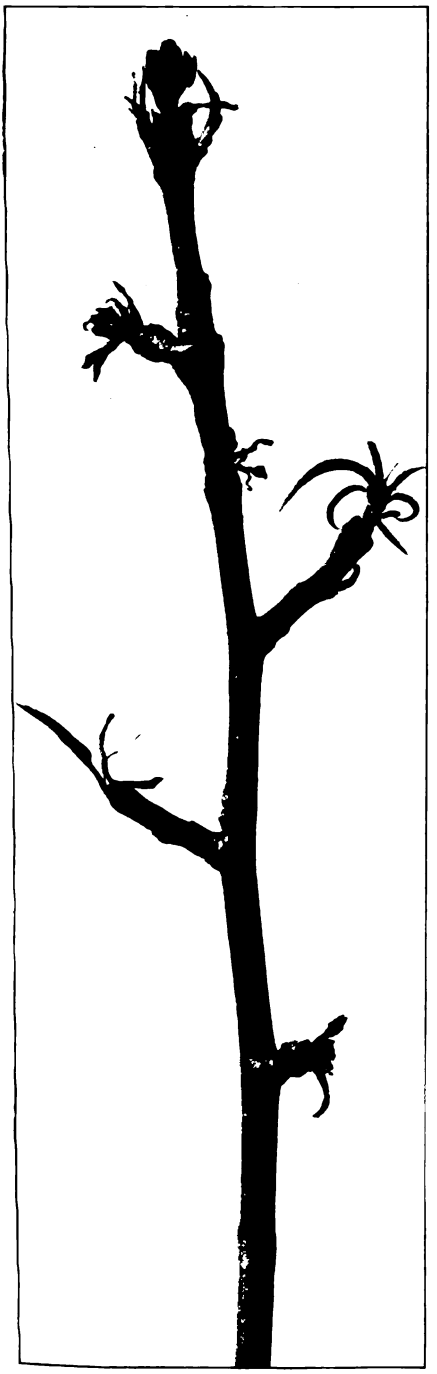
1 Twig showing nearly total destruction of blossom buds and rudimentary leaves

2 A similar branch with the leaves partly unfolded

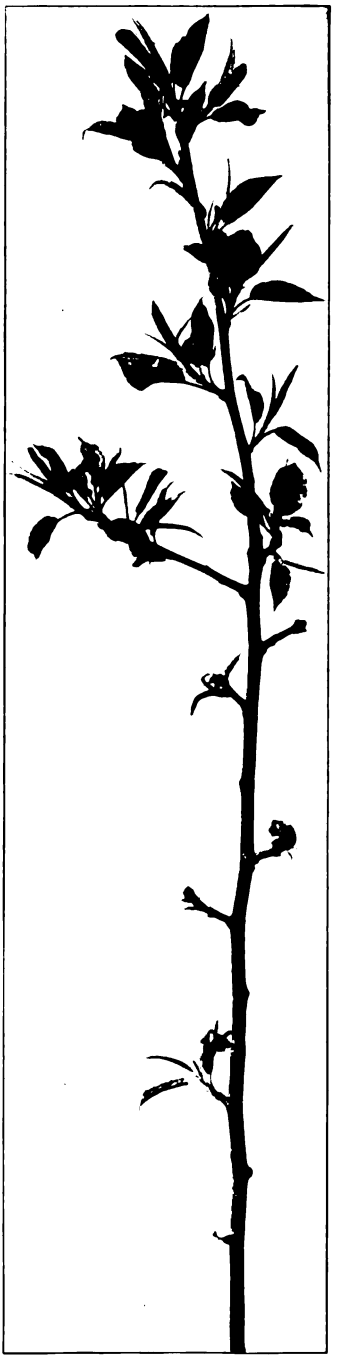
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Plate 1

1



2



Pear thrips work

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PLATE 2

[229]

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Pear thrips

Euthrips pyri Daniel

1 Cluster of buds in a condition favorable to attack by pear thrips
2 Fruit stem with buds seriously affected
3 A twig showing one cluster of buds somewhat enlarged by the thrips and several clusters of leaves illustrating the rolling and spoon-shaped deformity produced by this insect

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Plate 2

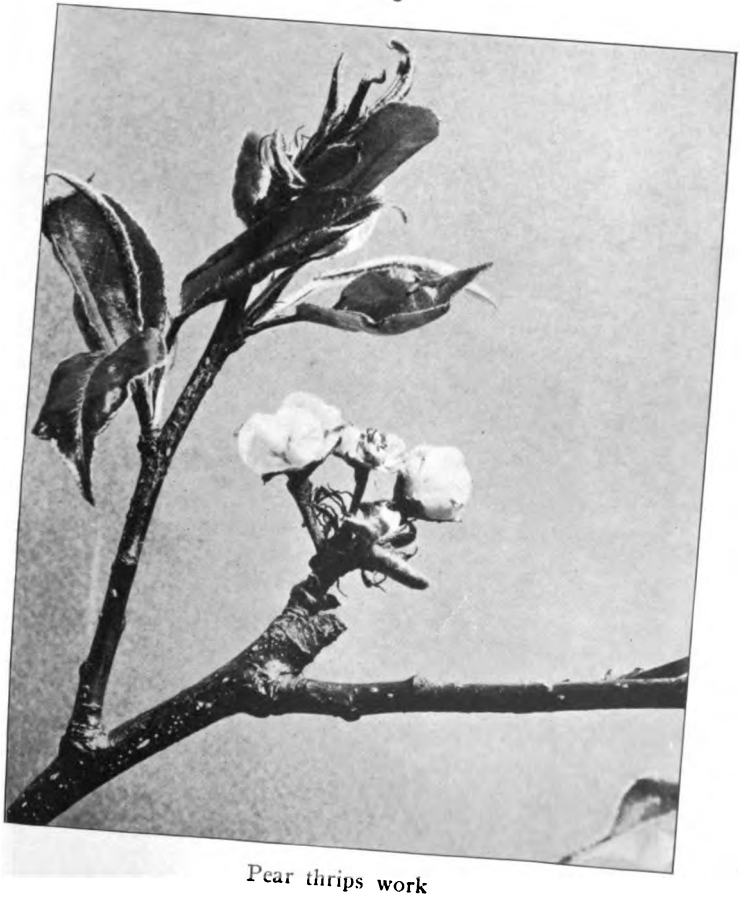
1



2



3



Pear thrips work

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PLATE 3

[231]

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Pear thrips

Euthrips pyri Daniel

1 Female thrips, greatly enlarged (x 40)
2 Wing of female (x 80)

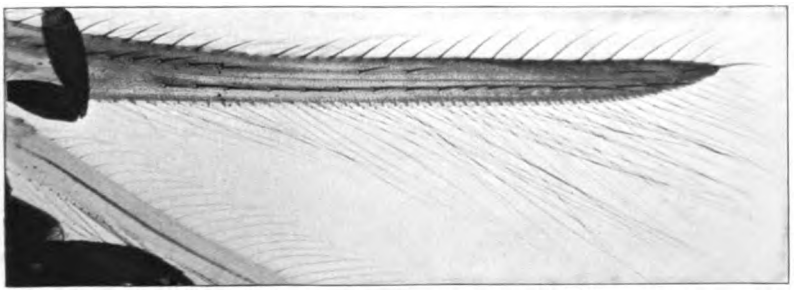
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Plate 3

1



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Pear thrips

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PLATE 4

[233]

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Queen blow fly

Phormia regina Meig.

1 Anterior extremity of first stage maggot, showing the cephalo-pharyngeal skeleton and the transverse bands of chitinous points (x 100)

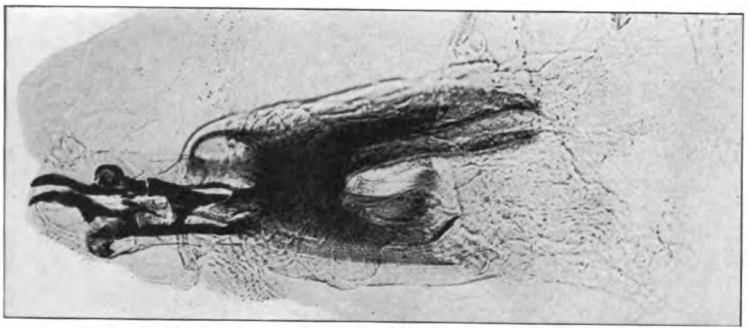
2 Anterior portion of second stage maggot, showing cephalo-pharyngeal skeleton (x 100)

3 Cephalo-pharyngeal skeleton of third stage maggot (x 66)

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Plate 4

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Queen blowfly larvae

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PLATE 5

[235]

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Queen blow fly

Phormia regina Meig.

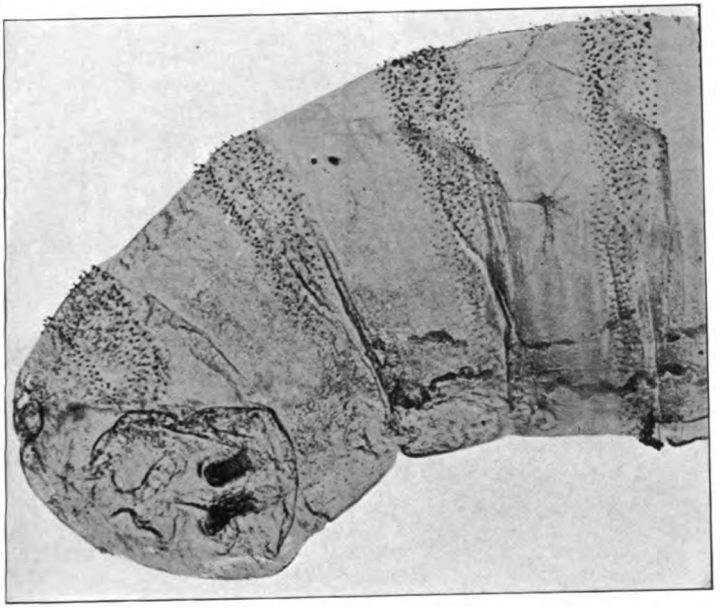
1 Posterior extremity of first stage maggot, showing the posterior pair of spiracles and the transverse bands of chitinous points (x 100)

2 Posterior spiracles of second stage maggot (x 200)

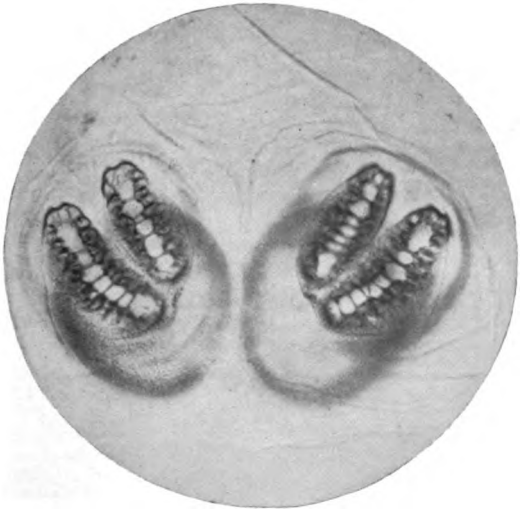
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Plate 5

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Queen blowfly larvae

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PLATE 6

[237]

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Queen blow fly

Phormia regina Meig.

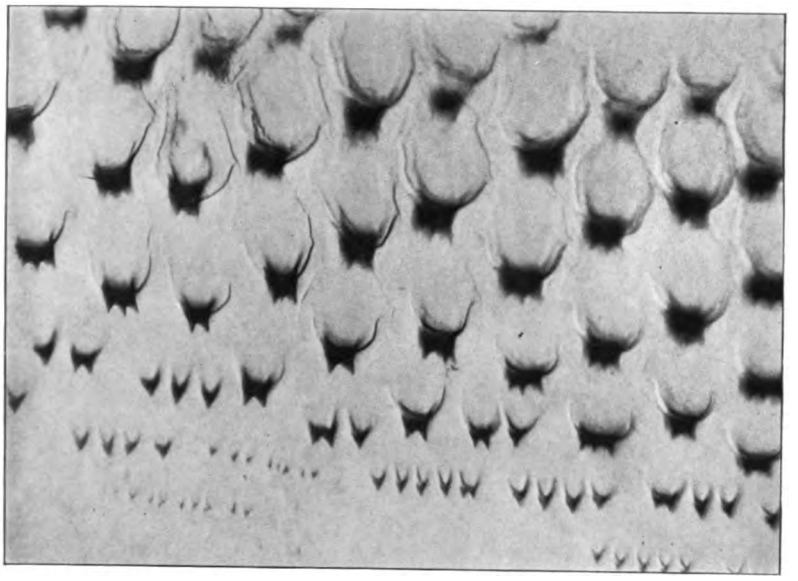
1 Portion of transverse band of chitinous points, greatly enlarged (x 200)

2 One posterior spiracle showing three orifices, each with a series of mostly transverse bars (x 200)

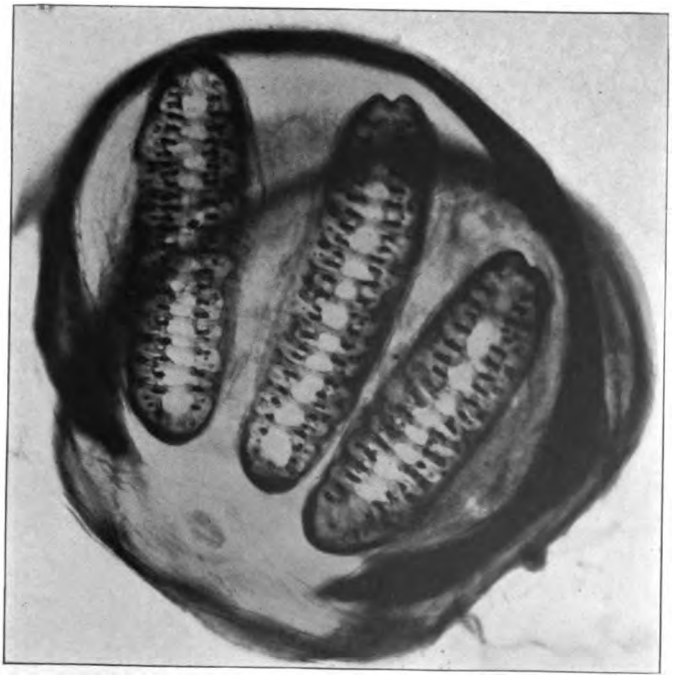
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Plate 6

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Queen blowfly larvae

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PLATE 7

[239]

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Georgian flesh fly

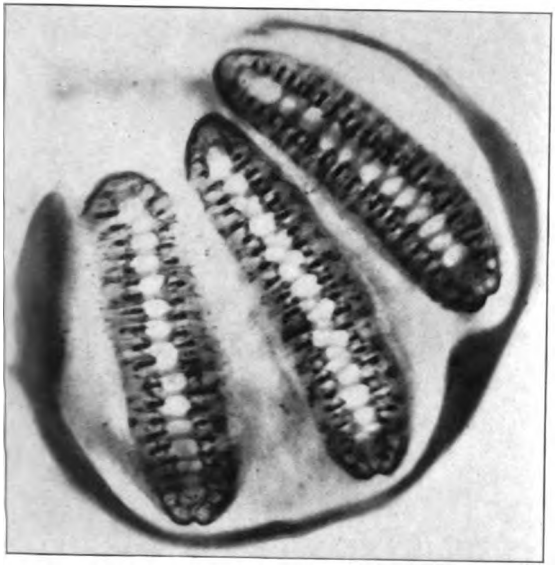
Sarcophaga georgina Wied.

1 Posterior spiracle showing three orifices and numerous anastomosing, oblique, chitinous bars (x 200)
2 Anterior spiracle showing the radially arranged orifices (x 100)
3 Cephalo-pharyngeal skeleton (x 80)
4 Portion of male genitalia (x 50)

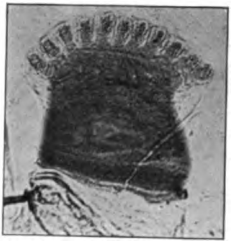
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Plate 7

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4



Georgian flesh fly

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PLATE 8

[241]

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Effects following the application of a miscible oil

1 View in Baldwin orchard set 19 years. Over 100 trees were in a dying condition following spraying the preceding fall. Photographed June 10, 1912

2 View in orchard of peach and apple trees set 12 years. Many of the apple trees are in a dying condition and were sprayed the preceding fall with a miscible oil. Photographed June 10, 1912

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Plate 8

1



2



Effects following the application of miscible oil

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PLATE 9

[243]

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Effects following the application of a miscible oil

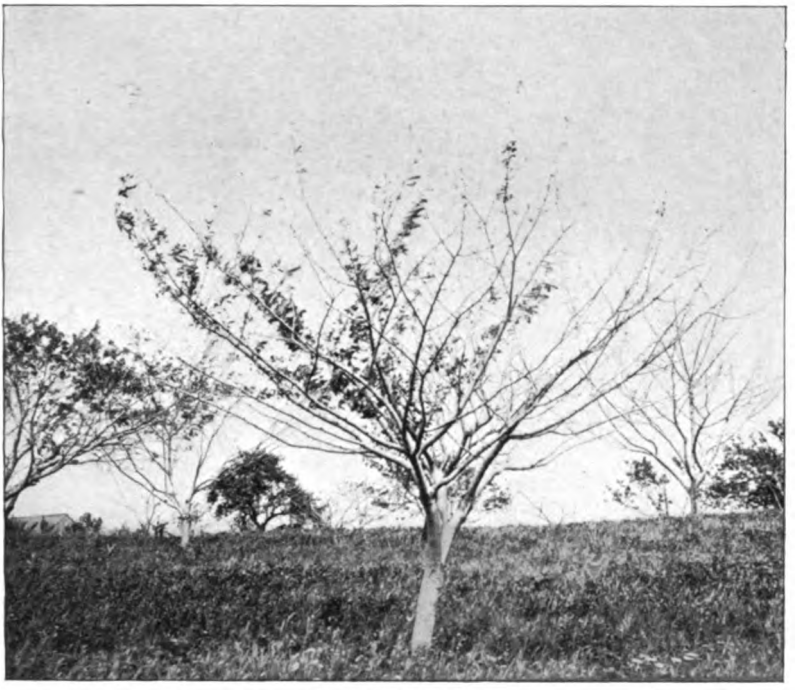
1 King tree sprayed in November 1911 with a miscible oil. One-half of this tree is dead. Photographed June 10, 1912

2 A view of the base of the same tree, more enlarged. Note the darker spots on the portion of the large limb from which the outer bark had been cut away, they being especially marked at the second fork on the base of a limb which was entirely dead. Photographed June 10, 1912

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Plate 9

1



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Effects following the application of miscible oil

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PLATE 10

[245]

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Pear midge

Contarinia pyrivora Riley

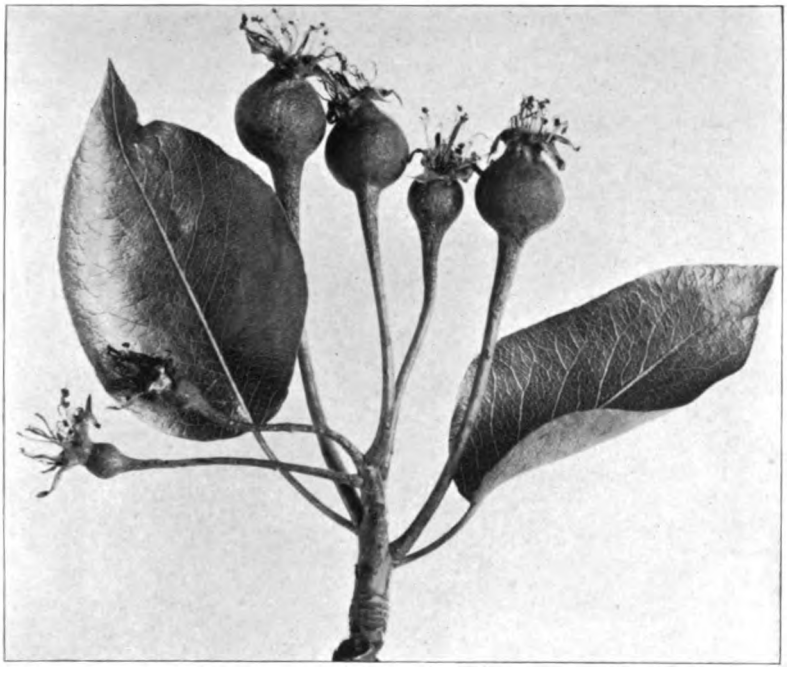
1 Cluster of pears showing four upright ones, three at least being abnormally swollen and globular, as a result of infestation by maggots

2 Similar pears opened to show the condition of the infested fruit

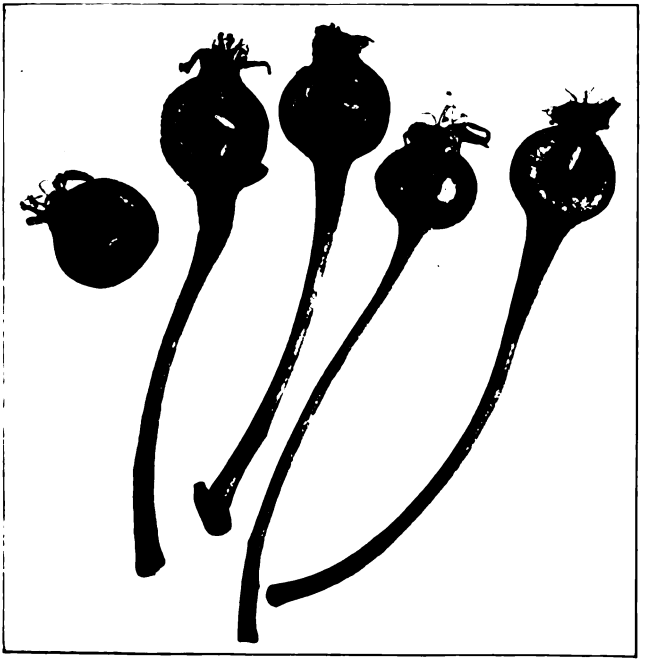
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Plate 10

1



2



Pear midge work

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PLATE 11

[247]

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Gall midge structures

1 Joannisia carolinae Felt (x 20)
2 Campylomyza vitinea Felt (x 20)
3 Campylomyza producta Felt (x 20)
4 Prionellus longipennis Felt (x 20)
5 Cordylomyia bryanti Felt (x 20)
6 Johnsonomyia rubra Felt (x 15)
7 Johnsonomyia fusca Felt, male genitalia (x 18c)

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Plate 11

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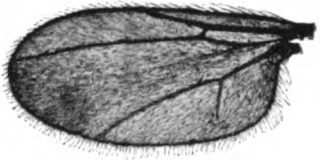
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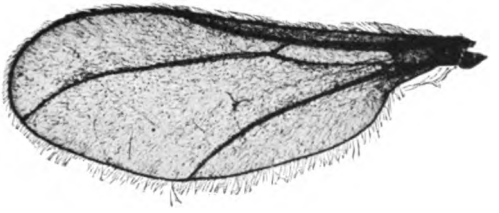
4



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Gall midge structures

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PLATE 12

[249]

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Gall midge genitalia

1 Monardia karnerensis Felt, male (x 260)
2 Monardia balsamicola Felt, male (x 260)
3 Prionellus hesperia Felt, male (x 260)
4 Campylomyza producta Felt, male (x 260)
5 Campylomyza pomifolia Felt, male (x 260)
6 Campylomyza pomiflorae Felt, male (x 260)

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Plate 12

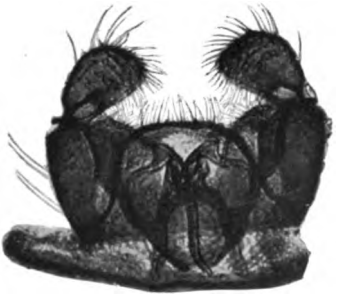
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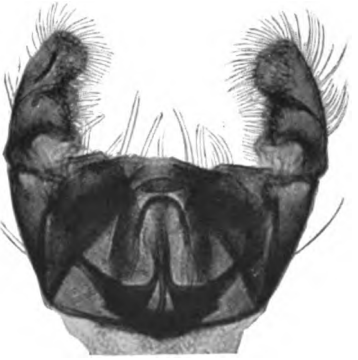
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Gall midge genitalia

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PLATE 13

[251]

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Gall midge anatomy

1 Monardia populi Felt, male genitalia (x 260)
2 Corinthomyia currei Felt, male genitalia (x 260)
3 Cordylomyia coprophila Felt, male genitalia (x 195)
4 Monardia lignivora Felt, anterior portion of larva, showing the tridentate breastbone (x 50)
5 Leptosyna americana Felt, male genitalia (x 260)
6 Kronomyia populi Felt, posterior extremity of female (x 125)

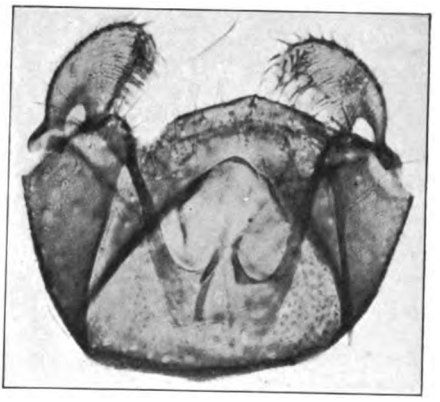
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Plate 13

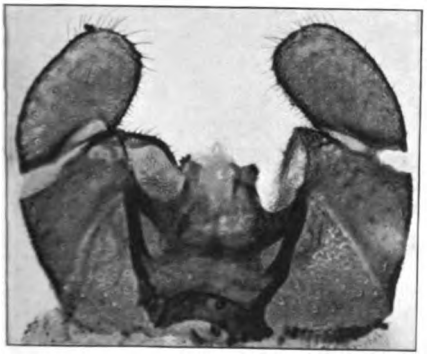
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Gall midge anatomy

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PLATE 14

|253|

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Miastor and Oligarces

1 Prepupa of Miastor
2 Pupa of Oligarces
3 Oligarces ulmi Felt, male
4 Oligarces ulmi Felt, female, showing eggs protruding from abdomen

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Plate 14

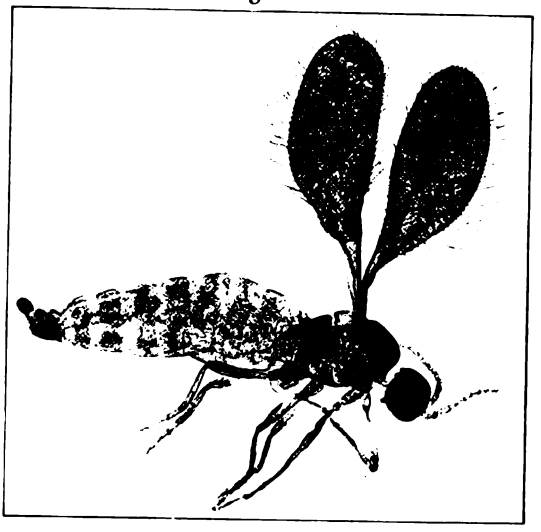
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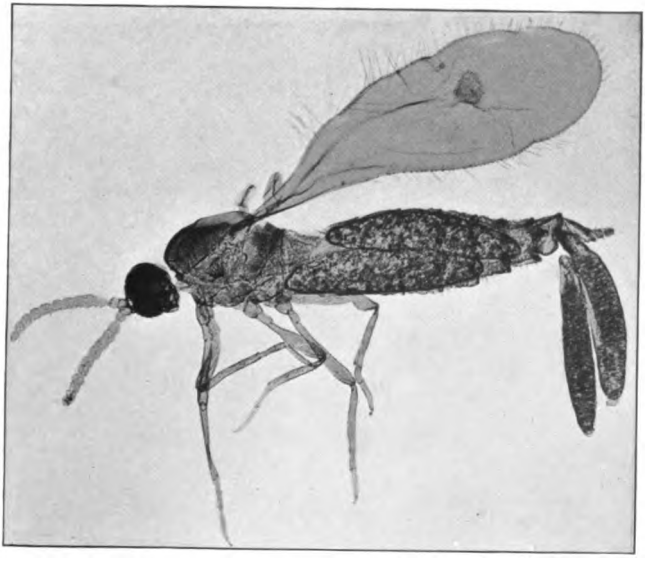
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3



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Miastor and Oligarces

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INDEX

Acarina, additions to collections, 126
acerifolia, Lestremia, 134, 139
aceris, Campylomyza, 154
  Chaitophorus, 106
acutipennis, Leptosyna, 215
Adalia bipunctata, 106
Additions to collections, 120–26
aestiva, Camptomyia, 118
Agrilus anxius, 101, 114
Alabama argillacea, 107–11
alexanderi, Monardia, 184, 187
Allorhina nitida, 57
allyni, Eupelmus, 39
Ambrosia beetles, 9, 103
americana, Asynapta, 118
  Catocha, 130–31
  Cimbex, 104
  Cordylomyia, 195, 199
  Leptosyna, 216
  Malacosoma, 94–95
  Miastor, 203
Anomala, two-spotted, 106
Anomala binotata, 106
Anomis erosa, 111
Anthrenus verbasci, 118
Anticarsia gemmatilis, 111
anxius, Agrilus, 101, 114
Apple leaf miner, 95–96
Apple tent caterpillar, 5, 94–95, 115
Apple tree, injurious insects:
  codling moth, 6, 13
  fruit tree bark beetle, 93
  Palmer worm, 96
  shield bearer, 95
Apple worm, *see* Codling moth
Apples, spraying, 115
Apriona bidentata, 183
Aprionus, 155, 182
  miki, 183
aptera, Wasmanniella, 156
araneosa, Clinodiplosis, 119
arcuata, Lachnosterna, 57
argillacea, Alabama, 107–11
Army worm, fall, 8, 42–47, 119
Arsenate of lead, 8, 18, 46, 50–52, 95, 97, 100, 115, 116
Arthrocnodax meridionalis, 115
  occidentalis, 120
articulosa, Monardia, 183, 185, 192–93
Asphondylia diplaci, 119
  enceliae, 119
  eupatorii, 113
  thalictri, 113
Asteromyia, 114
  grindeliae, 119
Asynapta americana, 118
atra, Campylomyza, 153
Aulonium bidentatum, 103
aurantiaca, Joannisia, 157
Autographa oxygramma, 111

balia, Lachnosterna, 57
balsamicola, Monardia, 185, 189
barberi, Catocha, 130, 131–32
  Lestremia, 134, 135–36
Barcurol, 65
Bark borers, 8
barlowi, Monardia, 185, 190
bergrothi, Bryomyia, 194
betheli, Oligotrophus, 119
bicolor, Campylomyza, 153
bidentata, Apriona, 183
bidentatum, Aulonium, 103
bifoveolatum, Ophion, 60
binotata, Anomala, 106
bipunctata, Adalia, 106
Birches, bronze birch borer injuring, 101
Blissus leucopterus, 119
Blowfly, 9
  queen, 75–79
Bluebottle fly, 75
Boeotomus subapterus, 40
borealis, Microcerata, 143, 147
boulderensis, Prionellus, 173, 177

Digitized by Google

Brachyneura, 219, 203, 204
eupatorii, 220, 221
fuscogrisea, 220
vitis, 217, 220–21
brevicornis, Cordylomyia, 194, 196–97
brevipes, Xuthia, 103
Bronze birch borer, 101, 114
Brown-tail moth, 7
bryanti, Cordylomyia, 194, 195
Bryomyia, 155, 193–94
bergrothi, 194
Bud moth, 115

calidum, Calosoma, 46
californica, Diarthronomyia, 117
Calliphora erythrocephala, 75
Calosoma calidum, 46
Camptomyia aestiva, 118
Campylomyza, 155, 164; key to genera, 154, 164–65
aceris, 154
atra, 153
bicolor, 153
carpini, 165, 171
cerasi, 165, 168
flavipes, 153, 164
flavoscuta, 165, 169–70
gibbosa, 165, 169
hirsuta, 200
modesta, 165, 170
pomiflorae, 165, 168
pomifolia, 165, 167
producta, 165, 166–67
scutellata, 164
texana, 165, 170–71
truncata, 118, 165, 170
vitinea, 164, 166
Campylomyzariae, 153
canadensis, Itonida, 113
Picea, 169
Sambucus, 136
Canker worms, 115
Carbolic acid, 66
Carbon bisulphid, 62
carinatus, Tetrastichus, 39
carolina, Epimyia, 203, 217
Mycodiplosis, 113
carolinae, Joannisia, 157, 158
carpini, Campylomyza, 165, 171
Carpocapsa pomonella, 13–31, 113
Case-bearers, 115
Catocha, 129–30; key to species, 130
americana, 130–31
barberi, 130, 131–32
latipes, 130
muscicola, 130
slossonae, 130, 132
Cecidomyia cerasiphila, 113
hopkinsi, 113
ocellaris, 150
Cecidomyiidae, 127
cerasi, Campylomyza, 165, 168
cerasiphila, Cecidomyia, 113
Ceratomyia, 154, 162
johannseni, 163
Chaitophorus aceris, 106
Chalepus dorsalis, 100, 119
nervosa, 100
Chastomera, 213
Chelonus texanus, 45
Chermes pinicorticis, 103
Chinch bug, 119
Chokecherry, apple tent caterpillar injuring, 94
Cicada, periodical, 9, 111–12, 114, 117
Cimbex americana, 104
cincinna, Corinthomyia, 200, 201–2
cincta, Itonida, 113
Johnsonomyia, 118, 211, 213
cinerea, Lestremia, 133
clarkeae, Parallelodiplosis, 113
Clinodiplosis araneosa, 119
Clover midge, 127
coccidarum, Dicrodiplosis, 113
coccidivora, Mycodiplosis, 113
Coccidomyia erii, 119
cockerelli, Microcerata, 143, 144
Codling moth, 6, 13–31, 113, 117; life history and habits, 14; experimental work, 14–18; tests in commercial orchards, 18–21; results of experiments, 21–26; comparative summary, 26–31; fight against, 114; spraying, 115; controlling, 115; experiments with, 116
Coleoptera, additions to collections, 121–22
Collections, 10; additions to, 120–26

Digitized by Google

coloradensis, Cordylomyia, 194, 195, 199–200
Janetiella, 119
Colpodia, 211
Contarinia johnsoni, 127
pyrivora, 97–99, 127
spiraeina, 113
coprophila, Cordylomyia, 194, 195, 197–98
Coptodisca splendoriferella, 95
Coquillettomyia knabi, 119
Cordyceps ravenelii, 61
Cordylomyia, 155, 194
americana, 195, 199
brevicornis, 194, 196–97
bryanti, 194, 195
coloradensis, 194, 195, 199–200
coprophila, 194, 195, 197–98
kasloensis, 195, 199
luna, 194, 196
sylvestris, 194, 195–96
tumida, 194, 197
versicolor, 195, 198
Corinthomyia, 155, 200
cincinna, 200, 201–2
currei, 200, 202
gracilis, 118, 200, 201
hirsuta, 200, 201
Corn, injurious insects:
fall army worm, 42
June beetles, 56
corni, Microcerata, 143, 145
Micromyia, 142
Cotalpa lanigera, 56
Cotton moth, 107–11
Cottony maple scale, 8
crassissima, Lachnosterna, 57
crenulata, Lachnosterna, 57
cucurbitae, Itonida, 113
Mycodiplosis, 113
currei, Corinthomyia, 200, 202

Dasyneura, 114
eugeniae, 118
leguminicola, 127
rhodophaga, 127
defectiva, Prionellus, 173, 174
destructor, Merisus, 39
Phytophaga, 31–41, 127
Diarthronomyia californica, 117
Dicrodiplosis coccidarum, 113
gillettei, 113
diervillae, Microcerata, 142, 143, 145
dietzii, Porricondyla, 118
dilatata, Prionellus, 173, 174, 178–79
diplaci, Asphondylia, 119
Lasioptera, 119
Diptera, additions to collections, 122
disstria, Malacosoma, 97, 99–100
domestica, Musca, 93
dorsalis, Chalepus, 100, 119
dubia, Lachnosterna, 57
dyari, Lestremia, 135, 141

Eccoptogaster quadrispinosa, 63–69, 113, 115
rugulosa, 90, 93
Elm leaf beetle, 8, 10, 47–55, 114, 118; destructive work in 1912, 48–50; experiments with, 50–52; results of spraying for, 52–55; control, 116
Elm sawfly, 104
Elms, Hawthorn sawfly injuring, 105; spraying, 116
elongata, Lestremia, 134, 135
enceliae, Asphondylia, 119
Entedon epigonus, 40
Entomology, economic, 119
epigonus, Entedon, 40
Epimyia, 204, 217
carolina, 203, 217
Erannis tiliaria, 111
erosa, Anomis, 111
erythrocephala, Calliphora, 75
eugeniae, Dasyneura, 118
eupatorii, Asphondylia, 113
Brachyneura, 220, 221
Eupatorium americana, 220, 222
perfoliatum, 220
Eupelmus allyni, 39
Euthrips pyri, 70–74
Explanation of plates, 227–54

Fall army worm, 42–47, 119; characteristics of outbreaks, 42; description, 42–43; larva, 43–44; food plants, 44–45; life history, 45; distribution, 45; natural enemies, 45–46; remedial measures, 46; bibliography, 46–47

Digitized by Google

False maple scale, 8
fasciata, Pero, 214
Fidia viticida, 50
Fig eater, 57
fitchii, Prodiplosis, 118
flavipes, Campylomyza, 153, 164
flavopedalis, Joannisia, 157
flavoscuta, Campylomyza, 165, 169–70
  Joannisia, 157, 159
Flesh fly, 9
  Georgian, 80–82
Flies, 9
  Georgian flesh fly, 80–82
  queen blowfly, 75–79
Forest insects, 8–9, 99–104
Forest tent caterpillar, 5, 97, 99–100, 117
franconiae, Lestremia, 134, 141
fraterna, Lachnosterna, 57
frenchii, Frontina, 45
Frirenia, 204, 216
  tenella, 216
Frontina frenchii, 45
frugiperda, Laphygma, 42–47, 119
Fruit tree bark beetle, 90, 93
Fruit tree insects, 6, 93–99
fulvus, Sparnopolius, 60
fungicola, Hyperdiplosis, 113
  Mycophila, 161
fusca, Johnsonomyia, 211, 212–13
  Lachnosterna, 56, 57
fuscogrisea, Brachyneura, 220

Galerucella luteola, 47–55, 114
Gall midges, 9–10, 115, 119, 127–226; new species, 113; violet, 127
gemmatilis, Anticarsia, 111
Georgian flesh fly, 80–82; biology, 80–81; description, 81–82; bibliography, 82
georgina, Sarcophaga, 9, 80–82
gibbosa, Campylomyza, 165, 169
  Lachnosterna, 57
gillettei, Dicrodiplosis, 113
  Monardia, 183, 184, 185–86
Gipsy moth, 6–7, 117
glaberrima, Lachnosterna, 57
Goldsmith beetle, 56
gracilis, Corinthomyia, 118, 200, 201
  Lachnosterna, 57
Grain pests, 7–8
graminea, Prionellus, 174, 180
grandis, Lachnosterna, 56, 57
Grape blossom midge, 127
Grapevine beetle, 56
Grapevine root worm, 50
Grass, injurious insects, 7–8
  fall army worm, 42
  June beetle, 56
Green maple worm, 5, 117
grindeliae, Asteromyia, 119
Ground beetles, 46

Haplusia, 204, 210
  plumipes, 210
Hawthorn sawfly, 104
Heliophila unipuncta, 42
Helobia punctipennis, 112
Hemiptera, additions to collections, 124–26
herrickii, Platygaster, 40
hesperia, Prionellus, 174, 181–82
Hessian fly, 7, 31–41, 127; causes of outbreak, 32–33; signs of infestation, 32; losses from in 1912, 33–37; food plants, 37; life history, 37; emergence of, 38–39; number of generations, 37–38; parasites, 39–40; preventive and remedial measures, 40–41; bibliography, 41
Heteropeza, 204, 209
  pygmaea, 209
  transmarina, 209
Heteropezinae, 202–26
Hickories, 114
Hickory bark borer, 8, 63–69, 113, 115; signs of infestation, 63–64; life history and habits, 64–65; experimental work, 65; preventive measures, 67–68; remedial measures, 68–69
Hickory trees, dying, 113
hirsuta, Campylomyza, 200
  Corinthomyia, 200, 201
  Lachnosterna, 56, 57
hirticola, Lachnosterna, 56, 57
Hispa, rosy, 100, 117
hopkinsi, Cecidomyia, 113
Hornbeam, forest tent caterpillar injuring, 99

Digitized by Google

House fly, 9, 93
Howard, L. O., identification of species through courtesy of, 12
Hymenoptera, additions to collections, 121
Hyperdiplosis fungicola, 113
producta, 115

ilicis, Lachnosterna, 57
Injurious insects, 13–82
inopis, Itonida, 118
inornata, Tiphia, 60
Insect pests, control of in institutions, 10, 114
Insects, number 11
intermedia, Strobliella, 155
Ips pini, 101
Iris borer, 117
Itonida canadensis, 113
cincta, 113
cucurbitae, 113
inopis, 118
pugionis, 113, 208
spiraeina, 113
taxodii, 113
tritici, 118, 127
Itonididae, 118, 119, 127–226

Janetiella coloradensis, 119
Joannisia, 154, 156; key to species, 157
aurantiaca, 157
carolinae, 157, 158
flavopedalis, 157
flavoscuta, 157, 159
latipennis, 160
neomexicana, 156, 157, 160
pennsylvanica, 156, 157, 159
photophila, 157, 158
johannseni, Ceratomyia, 163
johnsoni, Contarinia, 127
Microcerata, 143
Johnsonomyia, 204, 211
cincta, 118, 211, 213
fusca, 211, 212–13
rubra, 211, 212
June beetles, 56–62; characteristics, 56–57; New York species, 57
Juniper bug, 112
juniperina, Pentatoma, 112

kansensis, Lestremia, 134, 137–38
karnerensis, Monardia, 184, 188–89
Karschomyia townsendi, 119
kasloensis, Cordylomyia, 195, 199
Kerosene emulsion, 46, 62, 66, 96, 104
kiefferi, Stenoptera, 209
knabi, Coquillettomyia, 119
knochii, Lachnosterna, 57
Kronomyia, 204, 218
populi, 219

Lachnosterna, 57–58
sp. 56–62, 119
arcuata, 57
balia, 57
crassissima, 57
crenulata, 57
dubia, 57
fraterna, 57
fusca, 56, 57
gibbosa, 57
glaberrima, 57
gracilis, 57
grandis, 56, 57
hirsuta, 56, 57
hirticola, 56, 57
ilicis, 57
knochii, 57
marginalis, 57
micans, 57
nitida, 57
nova, 57
rugosa, 57
tristis, 56, 57
Ladybeetle, two-spotted, 106
lanigera, Cotalpa, 56
Laphygma frugiperda, 42–47, 119
Lasioptera, 114
diplaci, 119
verbenae, 119
Lasiopteryx manihot, 116
latipennis, Joannisia, 160
Prionellus, 173, 174, 179–80
latipes, Catocha, 130
Leaf feeders, 115
Ledomyiella, 204, 217
succini, 218
leguminicola, Dasyneura, 127
Prionellus, 174, 181

Digitized by Google

Lepidoptera, additions to collections, 122–24
Leptosyna, 214, 215
acutipennis, 215
americana, 216
quercivora, 203, 215
quercus (quercivora), 113
Lestodiplosis, 208
Lestremia, 129, 133; key to species, 134
acerifolia, 134, 139
barberi, 134, 135–36
cinerea, 133
dyari, 135, 141
elongata, 134, 135
franconiae, 134, 141
kansensis, 134, 137–38
leucophaea, 133–34
pini, 134, 138
sambuci, 134, 136–37
setosa, 134, 140
solidaginis, 134, 139
spiraeina, 134, 140
sylvestris, 134, 136
vernalis, 135, 142
Lestremiinae, 127
Lestremiinariae, key to, 129
leucophaea, Lestremia, 133–34
leucopterus, Blissus, 119
leveillei, Peromyia, 161
lignivora, Monardia, 184, 185, 191–92
ligulellus, Ypsolophus, 96–97
Lime tree winter moth, 111
Lime-sulphur wash, 14, 18
Lithomyza, 152
Locust, seventeen-year, 114
Locust leaf miner, 9, 100, 117, 119
Lonchaea polita, 208
longipennis, Prionellus, 173, 176
Lucilia sericata, 75
lucorum, Micromyia, 164
luna, Cordylomyia, 194, 196
luteola, Galerucella, 47–55, 114
Lysimachia quadrifolia, 139

Malacosoma americana, 94–95
disstria, 97, 99–100
malifoliella, Tischeria, 95–96
malus, Pyrus, 167
manihot, Lasiopteryx, 116
Maple leaf cutter, 117
Maple scale, cottony, 8
false, 8
Maple worm, green, 5, 117
Maples, injurious insects:
forest tent caterpillar, 99
ladybeetle, two-spotted, 106
marginalis, Lachnosterna, 57
marilandica, Neocatocha, 151
Meinertomyia, 204, 214
melinus, Palorus, 103
meridionalis, Arthrocnodax, 115
Merisus destructor, 39
metraloas, Miastor, 205
Meunieria, 204, 205
mexicana, Uleella, 113
Miastor, 114, 204, 205
americana, 203, 205–8; natural enemies, 208; life history, 208
metraloas, 205
micans, Lachnosterna, 57
Microcerata, 129, 142; key to species, 143
borealis, 143, 147
cockerelli, 143, 144
corni, 143, 145
diervillae, 142, 143, 145
johnsoni, 143
perplexa, 142, 143, 146–47
spinosa, 143, 145–46
texana, 143, 147–48
Micromyia, 155, 163
corni, 142
lucorum, 164
Midge galls, 114; identity, 10
miki, Aprionus, 183
Mite migration, 112
modesta, Campylomyza, 165, 170
Trichopteromyia, 161
Monardia, 155, 183
alexanderi, 184, 187
articulosa, 183, 185, 192–93
balsamicola, 185, 189
barlowi, 185, 190
gilletti, 183, 184, 185–86
karnerensis, 184, 188–89
lignivora, 184, 185, 191–92
pinicorticis, 184, 188
populi, 185, 189
stirpium, 183
toxicodendron, 184, 186–87
tuckeri, 185, 190–91

Digitized by Google

monilis, Prionellus, 173, 175
Monodicrana, 204, 210
  terminalis, 210
montana, Prionellus, 174, 182
mosellana, Thecodiplosis, 9, 118
Mosquito, control, 9, 106–7
Mountain ash, forest tent caterpillar injuring, 99
Musca domestica, 93
muscicola, Catocha, 130
Mycodiplosis carolina, 113
  coccidivora, 113
  cucurbitae, 113
  pulvinariae, 115
  spinosa, 113
Mycophila, 154, 161
  fungicola, 161
Myiasis interna, 93
Myzine sexcincta, 60

Necrophlebia, 214
  volitans, 214
Neocatocha, 129, 151
  marilandica, 151
  spinosa, 152
Neolasioptera, 114
neomexicana, Joannisia, 156, 157, 160
Neostenoptera, 204, 209
Neptunimyia, 129, 150
  tridens, 150
nervosa, Chalepus, 100
Neuroptera, additions to collections, 124
Neuroterus saltatorius, 105
nigricornis, Paridris, 150
nitida, Allorhina, 57
  Lachnosterna, 57
Notch wing, 117
nova, Lachnosterna, 57
noveboracensis, Oligarces, 223
Nursery inspection, 11

Oaks, injurious insects:
  forest tent caterpillar, 99
  Neuroterus saltatorius, 105
occidentalis, Arthrocnodax, 120
ocellaris, Cecidomyia, 150
Oils, use on dormant trees, 83–92
Oligarces, 114, 204, 223
  noveboracensis, 223
  paradoxus, 223
  ulmi, 203, 224–26
Oligotrophus betheli, 119
Ophion bifoveolatum, 60
Orthoptera, additions to collections, 126
oxygramma, Autographa, 111

Palaespaniocera, 204, 205
pallipes, Pteromalis, 40
Palmer worm, 96–97
Palorus melinus, 103
paradoxus, Oligarces, 223
Parallelodiplosis clarkeae, 113
Paridris nigricornis, 150
Peach trees, fruit tree bark beetle injuring, 93
Pear midge, 6, 97-99, 127
Pear thrips, 70–74, 116; description, 71–72; distribution in the Hudson valley, 70; life history, 72; injuries, 70; food plants, 72; distribution, 72–73; preventive measures, 73; remedial measures, 73–74; bibliography, 74
Pear tree, injurious insects:
  fruit tree bark beetle, 93
  pear thrips, 6
Pelidnota punctata, 56
Pentatoma juniperina, 112
pennsylvanica, Joannisia, 156, 157, 159
  Prunus, 168
  Youngomyia, 118
perfoliatum, Eupatorium, 220
Periodical cicada, 9, 111–12, 114, 117
Pero fasciata, 214
Peromyia, 154, 160
  leveillei, 161
perplexa, Microcerata, 142, 143, 146–47
Petroleum, 5; injury by, 83–85
Phormia regina, 9, 75, 80
photophila, Joannisia, 157, 158
Phytophaga destructor, 31–41, 127
  violicola, 127
Picea canadensis, 169

Digitized by Google

Pine, injurious insects:
bark borers, 8, 101
woolly bark louse, 9
Pine bark aphid, 103
Pine bark borer, 8, 101
pini, Ips, 101
Lestremia, 134, 138
Prionota, 172
pinicorticis, Chermes, 103
Monardia, 184, 188
pisoniae, Uleella, 115
pisonifolia, Uleella, 119
Plant lice, 116
Plant quarantine act, 7
Plates, explanation of, 227–54
Platygaster herrickii, 40
Platypus punctulatus, 103
Plum trees, fruit tree bark beetle injuring, 93
plumipes, Haplusia, 210
polita, Lonchaea, 208
Polyphylla variolosa, 56
pomiflorae, Campylomyza, 165, 168
pomifolia, Campylomyza, 165, 167
pomonella, Carpocapsa, 13–31, 113
populi, Kronomyia, 219
Monardia, 185, 189
porrecta, Porricondyla, 118
Porricondyla dietzii, 118
porrecta, 118
vernalis, 118
Potatoes, June beetle injuring, 56
Prionellus, 155, 172; key to species, 173
boulderensis, 173, 177
defectiva, 173, 174
dilatata, 173, 174, 178–79
graminea, 174, 180
hesperia, 174, 181–82
latipennis, 173, 174, 179
leguminicola, 174, 181
longipennis, 173, 176
monilis, 173, 175
montana, 174, 182
silvana, 173, 174–75
simulator, 173, 175
tsugae, 173, 176
Prionota pini, 172
Prodiplosis fitchii, 118
producta, Campylomyza, 165, 166–67
Hyperdiplosis, 115
Projoannisia, 154, 160
Prunus pennsylvanica, 168
Pseudotephritis vau, 208
Pteromalis pallipes, 40
Publications, 10, 113–20
pugionis, Itonida, 113, 208
pulvinariae, Mycodiplosis, 115
punctata, Pelidnota, 56
punctipennis, Helobia, 112
punctulatus, Platypus, 103
pygmaea, Heteropeza, 209
Pyrgota undata, 60
pyri, Euthrips, 70–74
pyrivora, Contarinia, 97–99, 127
Pyrus malus, 167

quadrifolia, Lysimachia, 139
quadripustulata, Winthemia, 45
quadrispinosa, Eccoptogaster, 63–69, 113, 115
Quarantine, 119
Queen blowfly, 75–79; methods used in experiments, 75; biology, 76–78; description, 78–79; bibliography, 79
quercina, Youngomyia, 113
quercivora, Leptosyna, 113, 203, 215

ravenelii, Cordyceps, 61
regina, Phormia, 9, 75, 80
Remedies and preventives:
arsenate of lead, 8, 18, 46, 50–52, 95, 97, 100, 115, 116
barcurol, 65
black leaf, 66
carbolic acid, 66
carbon bisulphid, 62
kerosene emulsion, 46, 62, 66, 96, 104
lime-sulphur wash, 14, 18
oils, 83–92
petroleum, 5, 83–85
scalecide, 66
tobacco preparation, 6, 73–74
tobacco soap, 116
whale oil soap, 67, 104

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Remedies and preventives for:
apple leaf miner, 96
apple tent caterpillar, 94, 95
bronze birch borer, 101
codling moth, 13, 14, 18
elm leaf beetle, 50–55, 114
forest tent caterpillar, 100
fruit tree bark beetle, 93
Hessian fly, 40–41
hickory bark borer, 65–69
locust leaf miner, 100
Palmer worm, 97
pear midge, 99
pear thrips, 6, 73, 116
pine bark aphid, 104
pine bark borer, 103
white grub, 62
Resplendent shield bearer, 95
Rhabdophaga, 114
rhodophaga, Dasyneura, 127
Rose leaf hopper, 117
Rose midge, 127
Rosy Hispa, 100, 117
rubra, Johnsonomyia, 211, 212
rugosa, Lachnosterna, 57
rugulosa, Eccoptogaster, 90, 93

sackeni, Tritozyga, 149
saltatorius, Neuroterus, 105
sambuci, Lestremia, 134, 136–37
Sambucus canadensis, 136
Sarcophaga georgina, 9, 80–82
Scalecide, 66
Scirpus silvaticus, 156
Scraping trees, 119
scutellata, Campylomyza, 164
septendecim, Tibicen, 111, 114
sericata, Lucilia, 75
setosa, Lestremia, 134, 140
sexcincta, Myzine, 60
sexdentatus, Tetradiplosis, 211
Shade tree pests, 8, 114, 117
Shield bearer, resplendent, 95
silvana, Prionellus, 173, 174
silvaticus, Scirpus, 156
simulator, Prionellus, 173, 175
slossonae, Catocha, 130, 132
solidaginis, Lestremia, 134, 139
Sparnopolius fulvus, 60
spinosa, Microcerata, 143, 145-46
Mycodiplosis, 113
Neocatocha, 152
spiraeina, Contarinia, 113
Itonida, 113
Lestremia, 134, 140
splendoriferella, Coptodisca, 95
Spraying, apparatus, 116; apples, 115; for codling moth, 115; elms, 116; fundamentals, 10, 118
Stenoptera kiefferi, 209
stirpium, Monardia, 183
Strawberries, injurious insects:
June beetle, 56
two-spotted Anomala, 106
Strobliella, 154, 155
intermedia, 155
subapterus, Boeotomus, 40
succini, Ledomyiella, 218
sylvestris, Cordylomyia, 194, 195–96
Lestremia, 134, 136

Tachina fly, 45
taxodii, Itonida, 113
tenella, Frirenia, 216
terminalis, Monodicrana, 210
Tetradiplosis, 210
sexdentatus, 211
Tetrastichus carinatus, 39
texana, Campylomyza, 165, 170–71
Microcerata, 143, 147-48
texanus, Chelonus, 45
thalictri, Asphondylia, 113
Thecodiplosis mosellana, 9, 118
zauschneriae, 119
Thysanoptera, additions to collections, 124
Thysanura, additions to collections, 126
tibialis, Trichiosoma, 104
Tibicen septendecim, 111–12, 114
tiliaria, Erannis, 111
Tiphia inornata, 60
Tischeria malifoliella, 95–96
Tobacco preparation, 6, 73–74
Tobacco soap, 116
torquatus, Xyleborus, 103
townsendi, Karschomyia, 119
toxicodendron, Monardia, 184, 186–87

Digitized by Google

transmarina, Heteropeza, 209
Trap strips, 41
Trees, dormant, use of oils on, 83-92; scraping, 119
Trichiosoma tibialis, 104
Trichopteromyia, 154, 161
  modesta, 161
tridens, Neptunimyia, 150
tristis, Lachnosterna, 56, 57
tritici, Itonida, 118, 127
Tritozyga, 129, 148
  sackeni, 149
truncata, Campylomyza, 118, 165, 170
tsugae, Prionellus, 173, 176
tuckeri, Monardia, 185, 190–91
tumida, Cordylomyia, 194, 197
Tussock moth, white-marked, 10, 118
Two-spotted Anomala, 106
Two-spotted ladybeetle, 106

Uleella (Bruggmaniella) mexicana, 113
  pisonia, 115
  pisonifolia, 119
ulmi, Oligarces, 203, 224–26
undata, Pyrgota, 60
unipuncta, Heliophila, 42

variolosa, Polyphylla, 56
vau, Pseudotephritis, 208
verbasci, Anthrenus, 118
verbenae, Lasioptera, 119
vernalis, Lestremia, 135, 142
  Porricondyla, 118
vernoniae, Youngomyia, 113
versicolor, Cordylomyia, 195, 198
Violet gall midge, 127
violicola, Phytophaga, 127
viticida, Fidia, 50
vitinea, Campylomyza, 164, 166
vitis, Brachyneura, 217, 220–21
volitans, Necrophlebia, 214

Wasmanniella, 154, 155
  aptera, 156
Whale oil soap, 67, 104
Wheat, Hessian fly injuring, 7, 31
Wheat midge, 9, 118, 127
White grubs, 7, 56–62, 119
White-marked tussock moth, 10, 118
Willow, Hawthorn sawfly injuring, 105
Winter moth, 111
Winthemia quadripustulata, 45
Woolly bark louse, 9

Xuthia brevipes, 103
Xyleborus torquatus, 103

Young, D. B., work of, 10
Youngomyia pennsylvanica, 118
  quercina, 113
  vernoniae, 113
Ypsolophus ligulellus, 96–97

zauschneriae, Thecodiplosis, 119

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ERRATA

Page 119, line 7 from the bottom, for arancosa read araneosa
Page 208, line 7 from the bottom, for Lonchae read Lonchaea

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NEW YORK STATE

REPORT OF OPERATIONS AND PRODUCTION DURING 1912

BY

D. H. NEWLAND

	PAGE
Introduction	5
Mineral production of New York	9
Cement	10
Clay	13
Production of clay materials	14
Manufacture of building brick	17
Other clay materials	22
Pottery	23
Crude clay	24
Emery	25
Feldspar	26
Garnet	29
Graphite	31
Gypsum	33
Iron ore	36
Mineral waters	40
Natural gas	44
Petroleum	48
Pyrite	52
Salt	53
Sand and gravel	57
Sand-lime brick	62
Stone	63
Production of stone	64
Granite	65
Limestone	70
Marble	78
Sandstone	91
Trap	99
Talc	98
Zinc	100
Index	107

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Hon. Pliny T. Sexton

Vice Chancellor of the University

SIR: I beg to communicate herewith for publication as a bulletin of the State Museum, our annual report on the Mining and Quarry Industry of New York, which has been prepared by D. H. Newland, Assistant State Geologist.

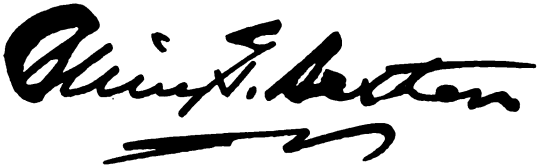
Very respectfully

JOHN M. CLARKE

Director

THE UNIVERSITY OF THE STATE OF NEW YORK

Approved for publication this 12th day of August 1913



Vice Chancellor of the University

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THE MINING AND QUARRY INDUSTRY

OF

NEW YORK STATE

REPORT OF OPERATIONS AND PRODUCTION DURING 1912

BY

D. H. NEWLAND

INTRODUCTION

The mineral resources of the State were very actively exploited in 1912 and the volume of business reported by many branches of the industry was of record proportions. In the face of the strong demand that prevailed throughout the year, prices for most products showed no marked advance; in fact they were but little above the average of the previous season, a period characterized by reaction and more or less pronounced depression. Under more favorable market conditions the yield, undoubtedly, would have reached a new figure; as it was the total fell short of the maximum by only a small amount.

A summary of the reports rendered by the mining and quarry enterprises throughout the State shows the actual value of the production to have been $36,552,784. This represented a gain of nearly 17 per cent, as compared with the amount reported for 1911, $31,730,747. The increase was more than enough to restore the

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loss incurred by the decline of the latter year and placed 1912 almost on a par with the record year of 1907 when the total reached $37,142,006.

The materials on which these production figures are based number over thirty and represent in most cases the first products of the mines and quarries. They do not of course cover the whole field of enterprise in this department of activity, since there are many large industries based on their further elaboration or manufacture, as well as others of equal importance engaged in the treatment of products secured from sources outside the State. Among such industries may be mentioned the manufacture of aluminum, calcium carbide, carborundum, pig iron and steel, soda products, coke, and many others that together greatly exceed in value of their outturn those branches under present consideration.

Among the metallic minerals found in the State, iron ore is the most valuable from an industrial standpoint. The gross output of this ore last year was 1,277,677 long tons. After allowance for concentration, which is practised by the Adirondack mines, there remained a total of 1,057,702 long tons of shipping ore which had a value of $3,349,095, as compared with 952,364 long tons valued at $3,184,057 for the year 1911. There was a good advance among the mines in the Clinton belt, though the magnetite ores as usual constituted the greater part of the production. New developments have been in progress which may lead to a material advance in the industry in the near future.

The clay-working industries contributed the largest items of the totals, with an aggregate value of $11,947,497 in 1912, and $9,751,659 in the preceding year. The large gain in production during the year was due largely to a better demand for structural materials, including common and pressed building brick, terra cotta, hollow fireproofing, etc., of which the total value amounted to $8,301,839, as compared with $6,473,857 in the preceding year. The number of brick for building purposes made in 1912 was 1,205,704 thousands, against 1,078,019 thousands in 1911, about three-fourths in each year being manufactured in the Hudson River district. The pottery trade also showed an improvement and the returns indicated a total value for the production of $2,876,762 which was a new record. About 200 firms were engaged in the various clay-working branches.

The improved conditions in the building trades also brought about an increased output of quarry materials, inclusive of granite, lime-

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stone, marble, sandstone and trap, which were valued in the aggregate at $5,718,994. The total for 1911 was $5,560,355. Divided according to uses the output for 1912 consisted of building stone valued at $692,534, monumental stone $103,641, curbstone and flagstone $621,327, crushed stone $2,754,839, and miscellaneous $1,546,653. More than one-half the value was returned by the limestone quarries which furnish the greater part of the crushed stone used for concrete and macadam. The marble and trap quarries were less active than usual, but there was a gain in both granite and sandstone.

In the cement trade, conditions showed a great improvement compared with their trend in recent years, which had been steadily reactionary. The demand for both portland and natural cement was brisk and prices advanced steadily with the progress of the season. The combined product of the two kinds amounted to 4,783,535 barrels, against 3,691,373 barrels in 1911. The gain was mostly recorded by the portland cement plants which contributed 4,495,842 barrels to the total, as compared with 3,416,400 barrels in the preceding year. Natural cement constituted an aggregate of 287,693 barrels, against 274,973 in 1911. Owing to the fact that the output of the mills was delivered largely under contracts, the value of the production averaged less than in 1911, though current prices were considerably higher.

Salt is a commodity that has been produced in the State for upwards of a century. It is obtained both by mining underground and by sinking wells into the salt, the brine from these being evaporated by solar or artificial heat, or used directly for chemical manufacture. The quantity of salt raised from the mines and wells in 1912 amounted to 10,502,214 barrels, and had a value at the place of production of $2,597,260, both totals exceeding those for any previous year. Livingston county, with the only active salt mines in the State, was the leading producer.

The mining of gypsum, the raw material from which plaster of paris and hard wall plasters are made, has become an important industry of late years, having had a very steady growth in the last decade. The material is mainly produced by underground operations, though in some localities it is quarried. The output for 1912 amounted to 506,274 short tons and in its marketable forms had a value of $1,186,845.

The combined value of petroleum and natural gas, the only representatives of the class of mineral fuels obtained in the State,

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amounted last year to $3,220,647. There was a material gain in the production of natural gas, the well flow having been 6,564,659 M. cubic feet against 5,127,571 M. cubic feet in 1911; but the oil industry was less active and returned an output of only 782,661 barrels, as compared with 955,314 barrels. The heavy decline in the crude oil market in 1910 was responsible in large measure for the decreased output last year, as it put a check upon new drilling that is necessary to maintain a balance with the depletion of old wells.

Among the minor industries in which New York has a prominent place by reason of its natural resources, are those of talc, garnet, graphite and pyrite. Talc is mainly obtained from a single district in St Lawrence county, which has a practical monopoly of the fibrous talc trade. The production last year amounted to 61,619 short tons valued at $511,437, or about the usual quantity. Garnet for abrasive use is produced in Essex and Warren counties, and the output last year was 4112 short tons with a value of $117,325. Graphite of the more valuable crystalline sort is found in the Adirondack region; the total product last year was reported as 2,628,000 pounds and represented a value of $142,665. Pyrite for acid manufacture is mined in St Lawrence county.

The remaining mineral materials represented in the list of products for last year included apatite, clay, diatomaceous earth, emery, feldspar, marl, millstones, metallic paint, mineral waters, slate pigment, quartz, slate, sand, sand-lime brick, and zinc ore. There were no additions to the list during the year, but on the other hand one industry — that connected with the production of carbon dioxid from natural sources — was discontinued as the result of the recent action taken for the conservation of the Saratoga mineral waters.

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Mineral production of New York in 1911

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	3 416 400	$2 930 434
Natural-rock cement	Barrels	274 973	134 900
Building brick	Thousands	1 078 019	5 443 303
Pottery	.....	.....	2 196 054
Other clay products	.....	.....	2 083 405
Crude clay	Short tons	14 193	11 982
Emery	Short tons	769	8 810
Feldspar and quartz	Short tons	21 802	75 719
Garnet	Short tons	4 285	121 759
Graphite	Pounds	2 510 000	137 750
Gypsum	Short tons	446 794	1 092 598
Iron ore	Long tons	952 364	3 184 057
Millstones	.....	.....	13 177
Metallic paint	Short tons	7 237	68 870
Slate pigment	Short tons	1 646	12 864
Mineral waters	Gallons	8 923 628	756 147
Natural gas	1000 cubic feet	5 127 571	1 547 077
Petroleum	Barrels	955 314	1 251 461
Pyrite	Long tons	53 453	251 466
Salt	Barrels	10 082 656	2 191 485
Sand and gravel	.....	.....	1 727 367
Sand-lime brick	Thousands	15 178	92 064
Roofing slate	Squares	11 273	52 311
Slate manufactures	.....	.....	Nil
Granite	.....	.....	148 633
Limestone	.....	.....	3 174 161
Marble	.....	.....	278 041
Sandstone	.....	.....	1 060 106
Trap	.....	.....	899 414
Talc	Short tons	65 000	552 500
Other materials [1]	.....	.....	232 832
Total value	.....	.....	$31 730 747

[1] Includes apatite, carbon dioxid, diatomaceous earth, marl and zinc ore.

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Mineral production of New York in 1912

PRODUCT	UNIT OF MEASUREMENT	QUANTITY	VALUE
Portland cement	Barrels	4 495 842	$3 488 931
Natural-rock cement	Barrels	287 693	142 165
Building brick	Thousands	1 205 704	6 889 940
Pottery			2 876 762
Other clay products			2 180 795
Crude clay	Short tons	8 583	18 980
Emery	Short tons	589	6 479
Feldspar and quartz	Short tons	28 584	115 419
Garnet	Short tons	4 112	117 325
Graphite	Pounds	2 628 000	142 665
Gypsum	Short tons	506 274	1 186 845
Iron ore	Long tons	1 057 702	3 349 095
Millstones			15 358
Metallic paint	Short tons	8 012	72 176
Slate pigment	Short tons	1 750	12 800
Mineral waters	Gallons	9 682 447	760 847
Natural gas	1000 cubic feet	6 564 659	1 882 297
Petroleum	Barrels	782 661	1 338 350
Pyrite	Long tons	58 137	286 577
Salt	Barrels	10 502 214	2 597 260
Sand and gravel			2 549 729
Sand-lime brick	Thousands	21 231	133 736
Roofing slate	Squares	9 738	83 222
Slate manufactures			Nil
Granite			202 096
Limestone			3 510 445
Marble			241 847
Sandstone			1 280 743
Trap			483 863
Talc	Short tons	61 619	511 437
Other materials [1]			74 600
Total value			$36 552 784

[1] Includes apatite, diatomaceous earth, marl and zinc ore.

CEMENT

The cement business last year was of large volume, but in the early months was conducted on a small margin of profit to the manufacturer. Prices showed, however, an upward trend with the progress of the season, the first really sustained improvement in the market that had taken place for some time. This lent an encouraging aspect to the year's record as compared with that of 1910 or 1911, and appeared to indicate that the critical period which tested the financial and technical equipment of the plants as never before had been passed.

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The opening of the year found the companies carrying heavy stocks and prices on the same low level they reached in the latter part of the preceding season. Demand was exceptionally heavy and served to absorb most of the surplus in the next few months, so that by spring the mills were able to make a slight advance in quotations. There was no check to activity and in midsummer an additional increase was made, followed by others from time to time until by December, New York prices reached a level fully 50 per cent higher than that at the beginning of the year. The actual price movement was from about 60 cents a barrel in January to 95 cents a barrel in December, the quotations being for cement in bulk at the mill. Inasmuch as much of the selling by the manufacturers is on contract, they were, of course, not able to realize the full benefits of the advance and the average basis on which the year's sales were made may be placed at around 78 cents.

The natural cement trade in which New York State is still represented, though to a much smaller extent than formerly, followed practically the same course as indicated for the portland branch. The demand was active and at increasing prices with the season's advance. Owing to the adverse conditions experienced by manufacturers in the few preceding years, more serious in their case than in that of the portland cement companies, their plants were not in shape to allow them to take much advantage of the conditions; consequently, the outturn was not materially different from the figure reported for 1911.

In volume of production, the year was notable, the total having been exceeded but once or twice in the history of the industry. The actual quantity of portland and natural cements manufactured was 4,783,535 barrels as compared with 3,691,373 barrels in 1911 and 3,657,015 barrels in 1910. The only other years that made a comparable showing were in the period from 1895 to 1900 when the natural cement business was at the height of prosperity and contributed an output about equal to that reported last year by the portland mills.

As shown in the accompanying tables, the production of portland cement in 1912 reached the figure of 4,495,842 barrels, against 3,416,400 barrels in 1911. Its value was $3,488,931, as compared with $2,930,434 in the preceding year. The average value of the product, however, was only 77.6 cents a barrel, against 85.8 cents for 1911. There were seven mills in operation during the year, the same number as reported active in 1911.

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The output of natural cement amounted to 287,693 barrels, valued at $142,165, the larger part of which was contributed by a single plant in the Rosendale district of Ulster county. The total for 1911 was 274,973 barrels with a value of $134,900. The average value was approximately 50 cents a barrel in both years. Aside from Ulster county, the only other county which was represented in the industry was Onondaga with three small plants.

Production of cement in New York

YEAR	PORTLAND CEMENT		NATURAL CEMENT	
	Barrels	Value	Barrels	Value
1892	124 000	$279 000	3 780 687	$3 074 781
1893	137 096	287 725	3 597 758	2 805 387
1894	117 275	205 231	3 446 330	1 974 463
1895	159 320	278 810	3 939 727	2 285 094
1896	260 787	443 175	4 181 918	2 423 891
1897	394 398	690 179	4 259 186	2 123 771
1898	554 358	970 126	4 157 917	2 065 658
1899	472 386	708 579	4 689 167	2 813 500
1900	465 832	582 290	3 409 085	2 045 451
1901	617 228	617 228	2 234 131	1 117 066
1902	1 156 807	1 521 553	3 577 340	2 135 036
1903	1 602 946	2 031 310	2 417 137	1 510 529
1904	1 377 302	1 245 778	1 881 630	1 207 883
1905	2 117 822	2 046 864	2 257 698	1 590 689
1906	2 423 374	2 766 488	1 691 565	1 184 211
1907	2 108 450	2 214 090	1 137 279	757 730
1908	1 988 874	1 813 622	623 588	441 136
1909	2 061 019	1 761 297	549 364	361 605
1910	3 364 255	2 939 818	292 760	147 202
1911	3 416 400	2 930 434	274 973	134 900
1912	4 495 842	3 488 931	287 693	142 165

With continued favorable conditions in the market, a further increase in the State's cement industry may be expected. The annual total should soon exceed 5,000,000 barrels, and it is certain that the local portland industry is destined to become a very prominent factor in that trade.

For the current year, the increment of an additional plant will appear in the total, as the Millen Portland Cement Co. began operations on April 1st. This company built a new mill at Jamesville, Onondaga county, a few years ago, but did not start production

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until this spring. The mill has a capacity of 700 barrels a day. The materials used are limestone from the large quarries of the Solvay Process Co., nearby, and local clays.

CLAY

The clay deposits in the State are not noteworthy for their variety of character or industrial adaptability, and in fact are mainly restricted to the common sorts useful for ordinary building brick and materials of that class. They are widely distributed, however, so that practically every center of population is or may be supplied with clay structural materials from nearby yards. This branch of the industry is consequently of the greatest importance, the continued rapid expanse of population in the larger cities furnishing a market that is scarcely rivaled by that of any other state.

The clays that are utilized in brick manufacture are, with few exceptions, modified glacial deposits. Residual clays are practically absent. They have been transported from the Adirondacks and other regions of accumulation, or produced by the abrading action of the ice upon shales, and deposited in the streams and lakes that existed along the margin of the ice sheet. The most extensive beds occur in the Hudson and Champlain valleys which in late Glacial time were occupied by lakes which reached high above the present water levels. In the Hudson valley they are interstratified with sands and gravels, and build terraces on either side which lie at different elevations up to 300 feet or more. The workable clays often attain a thickness of 50 feet and in some places they exceed 100 feet. The clays have a bluish color, but are weathered to brown or yellow for some distance from the surface. They contain relatively high percentages of iron, lime and other fluxing ingredients and consequently fuse at a relatively low temperature. The color of the burned clay is generally red.

Glacial clays, more or less modified by water sorting, are also abundant in the interior and western parts, specially in the larger stream valleys. Syracuse, Rochester and Buffalo have rather extensive brick manufacturing industries which supply the local markets. Clay suitable for stoneware is found near Syracuse.

In addition to common brick, which is the principal article produced from these clays, the list of manufactures includes drain tile, hollow blocks, fireproofing and earthenware.

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On Long Island and Staten Island are found local deposits of Cretaceous clays, similar to those of New Jersey. They have been utilized to some extent for stoneware and brick by Long Island manufacturers, but the principal developments have been at Kreischerville and Green Ridge, Staten Island. At Kreischerville, excellent grades of fire brick and fancy pressed brick are made from these clays.

Besides the surficial clays, the shale beds which are found in the Paleozoic strata, especially of the Devonic system, afford much material that is adapted for building and paving brick, terra cotta, tile etc. They are utilized mainly in the southern and western sections. Among the localities where they are worked are Angola and Jewettville, Erie county; Jamestown, Chautauqua county; Alfred Center, Allegany county; and Corning, Steuben county. At Catskill, on the Hudson, building and paving brick are made from Hamilton shale that is dug at Cairo.

The manufacture of porcelain and chinawares has become an important branch of the industry, having shown a quite remarkable growth during the last decade. Its importance, however, is ascribable to the local facilities for assembling the raw materials and marketing the finished products. The kaolin and ball clays for the purpose are brought in from the southern states, and some of the kaolin is imported from England. The quartz and feldspar mostly come from New England, though of these materials New York possesses considerable resources which would seem to be capable of supplying some of the local requirements.

PRODUCTION OF CLAY MATERIALS

The accompanying tables give the production of clay materials during the last two or three years, the statistics being arranged according to items of manufacture and also, so far as practicable, according to counties in which the operations were carried on. They are based on reports submitted by the individual plants.

There was some improvement in the conditions affecting the clay-working industry last year as compared with those prevailing in 1910 and 1911, most noticeable in the increased output of building brick, which represents in value about one-half the entire production. The gain may be considered as indicative of a more normal state of business, after the pronounced depression that characterized the previous season, but did not suffice to bring the

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total up to a new record. It was mostly contributed by the brick manufacturers in the Hudson valley, who sell in the New York market. The average prices in that important center were considerably above those reported for 1910 and 1911.

Among the other branches of the clay-working industry, those of pottery and terra cotta also showed good increases, the production of pottery being much the largest ever reputed. The remaining products, inclusive of paving brick, fire brick, drain tile, sewer pipe and fireproofing were manufactured on a reduced scale.

The actual value of the production of clay materials of all kinds in 1912 was $11,947,497 as compared with a value of $9,751,659 in 1911 and $11,518,982 in 1910. The gain for the year was $2,195,838 or about 23 per cent. The largest value recorded for any year was in 1906 when it amounted to about $14,000,000.

Production of clay materials

MATERIAL	1910	1911	1912
Common brick	$6 563 212	$5 310 511	$6 646 436
Front brick	119 859	132 792	243 504
Vitrified paving brick	333 511	307 529	174 048
Fire brick and stove lining	464 693	413 500	380 005
Drain tile	254 679	202 292	122 571
Sewer pipe	137 731	138 258	77 644
Terra cotta	1 062 017	718 700	1 139 291
Fireproofing	256 820	229 627	230 833
Building tile	65 190	82 217	42 575
Miscellaneous	134 752	20 179	13 828
Pottery	2 136 518	2 196 054	2 876 762
Total	$11 518 982	$9 751 659	$11 947 497

The product of common building brick had a value of $6,646,436 as compared with $5,310,511 in 1911, representing an increase of $1,335,925. Front brick also showed an increase, with a total value of $243,504, against $132,792. Vitrified paving brick accounted for a value of $174,048, as against $307,529, the large decrease being due to a suspension of operations by one of the larger manufacturers. Fire brick and stove lining were valued at $380,005, as compared with $413,500 in the preceding year. The output of drain tile fell off very considerably, with a total of $122,571, against $202,292 in 1911. Similarly, that of sewer pipe

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amounted to only $77,644, against $138,258 in 1911. The production of terra cotta was valued at $1,139,291, as compared with $718,700; of fireproofing at $230,833, against $229,627; and of building tile, inclusive of roofing and floor tile, at $42,575, against $82,217. The miscellaneous clay manufactures, including such items as flue lining, fire tile and shapes, conduit pipes and acid-proof brick, amounted to $13,828, against $20,179 in 1911. The potteries of the State reported an output valued at $2,876,762, against $2,196,054 in the preceding year.

Of the 38 counties in the State that had representation in the clay-working industry last year, Onondaga stood at the head in the value of its product which reached a total of $1,368,345. In 1911 it also held the same place with a value of $912,892. The greater part of the product consisted of pottery which is an important industry in Syracuse and vicinity. Ulster county ranked second in the list and contributed a total of $1,296,779, all reported by the brick yards in the Hudson River section. Rockland county displaced Erie county which held third place in the previous years by reporting a value of $994,967, also represented by common building brick. Erie county with a diversified industry that includes most of the common clay manufactures besides pottery ranked fourth with products valued at $810,516. The other counties that reported a value exceeding $500,000 were Dutchess ($665,082) Orange ($615,155) Kings ($574,805) and Schenectady ($539,928).

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Production of clay materials by counties

COUNTY	1910	1911	1912
Albany	$641 227	$470 503	$457 694
Allegany	*a*	9 000	*a*
Cattaraugus	63 887	90 153	135 480
Cayuga	20 675	15 724	3 740
Chautauqua	129 331	166 322	113 315
Chemung	*a*	76 169	79 510
Columbia	454 550	284 475	381 888
Dutchess	649 862	648 151	665 082
Erie	841 726	755 602	810 516
Greene	266 452	139 578	202 306
Jefferson	7 997	*a*	3 630
Kings	569 720	602 756	574 805
Livingston	*a*	70 295	125 642
Monroe	264 421	325 849	246 264
Montgomery	*a*	*a*	14 400
Nassau	111 650	105 740	119 708
New York	*a*	*a*	56 884
Niagara	22 882	25 426	22 357
Oneida	126 907	95 605	85 975
Onondaga	833 892	912 892	1 368 345
Ontario	269 549	255 298	341 617
Orange	761 500	565 152	615 155
Queens	551 375	402 398	613 605
Rensselaer	348 172	173 564	169 179
Richmond	633 010	470 591	723 875
Rockland	1 080 117	747 040	994 967
Saratoga	388 428	393 490	516 632
Schenectady	505 966	486 327	539 928
Steuben	219 615	149 649	181 663
Suffolk	101 560	73 750	92 150
Ulster	1 121 460	829 035	1 296 779
Warren	*a*	*a*	17 875
Washington	3 685	10 350	19 620
Westchester	371 328	297 997	344 798
Other counties *b*	158 038	102 778	12 113
Total	$11 518 982	$9 751 659	$11 947 497

a Included under other counties.
b In 1910, aside from counties marked (*a*), are included Genesee, St Lawrence, Tioga, Tompkins and Wayne counties. In 1911, aside from counties marked (*a*), are included Clinton, Genesee, St Lawrence, Tompkins and Wayne counties. In 1912, aside from counties marked (*a*), are included Clinton, St Lawrence, Tompkins and Wayne counties.

MANUFACTURE OF BUILDING BRICK

The manufacture of building brick is the most important branch of the clay-working industry, with regard both to the number of plants represented and the value of the product. Altogether there were 152 yards that reported as active last year, distributed among 31 counties. The total number of common brick made was

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1,187,973,000. This represented an increase over the number manufactured in the preceding year, which totaled 1,066,982,000. The gain came from the counties along the Hudson river, from Rensselaer county southward, and was due to the improvement in the building trades in New York and other large cities in the vicinity. The New England trade also showed a better demand, as instanced by the increase in the production of the plants which shipped mainly to that market, notably those of Saratoga county.

The value of the common brick made last year was $6,646,436, or an average of $5.59 a thousand, as compared with $5,310,511, an average of $4.98 a thousand in 1911. The rise in prices indicated by this comparison was very substantial and the season on the whole may be considered as quite prosperous in this branch of the industry. Since 1910 the selling value at the yards has increased nearly 20 per cent.

In addition to the common building brick, there were manufactured last year 17,731,000 front or fancy brick with a value of $243,504. The output for 1911 numbered 11,037,000 valued at $132,792. The aggregate production of brick for building purposes was thus 1,205,704,000 valued at $6,889,940.

A feature of the record that appears on comparison of the statistics for several years past is the marked falling off in the number of plants and the tendency toward the restriction of the active industry to those localities or districts which possess natural advantages for manufacturing or marketing the product. As the annual output has been maintained at a fairly even rate, aside from fluctuations due to market influences, this indicates that the average outturn has enlarged very considerably, no doubt with resulting economies. In 1906, for instance, there were 231 yards in operation, distributed among 37 counties.

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Production of common building brick

COUNTY	1911		1912	
	Number	Value	Number	Value
Albany	59 517 000	$319 503	69 100 000	$381 694
Cattaraugus	1 088 000	8 109	570 000	4 510
Cayuga	1 813 000	11 724	.....	.....
Chautauqua	4 140 000	28 406	3 040 000	20 483
Chemung	.....	.....	12 300 000	79 510
Columbia	57 695 000	284 475	69 434 000	381 888
Dutchess	133 229 000	648 151	122 085 000	665 082
Erie	35 975 000	222 673	43 184 000	277 696
Greene	28 779 000	139 578	36 573 000	199 360
Livingston	425 000	2 550	.....	.....
Monroe	21 100 000	116 600	22 632 000	147 107
Montgomery	.....	.....	3 200 000	14 400
Nassau	15 790 000	98 445	15 399 000	105 048
Niagara	3 178 000	25 426	3 114 000	22 357
Oneida	14 434 000	93 105	12 525 000	79 575
Onondaga	22 000 000	132 750	16 985 000	119 134
Ontario	.....	.....	2 500 000	16 250
Orange	121 800 000	565 152	113 363 000	615 155
Rensselaer	13 352 000	67 760	13 800 000	76 452
Richmond	23 456 000	106 823	33 297 000	175 358
Rockland	162 400 000	747 040	184 595 000	994 967
Saratoga	81 575 000	392 427	103 210 000	516 632
St uben	.....	.....	1 988 000	13 922
Suffolk	11 500 000	68 750	15 200 000	92 150
Ulster	178 287 000	829 035	231 550 000	1 296 779
Warren	.....	.....	3 575 000	17 875
Westchester	52 654 000	263 498	52 844 000	318 422
Other counties *a*	22 795 000	138 531	1 910 000	14 630
Total	1 066 982 000	$5 310 511	1 187 973 000	$6 646 436

a Includes in 1911 Chemung, Clinton, Montgomery, Ontario, St Lawrence, Tompkins, Warre,n and Washing·on counties. Includes in 1912 Cayuga, Clinton, Jefferson, Livingston, St Lawrence Tompkins and Washington counties.

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Output of common brick in the Hudson River region in 1911

COUNTY	NUMBER OF PLANTS	OUTPUT	VALUE	AVERAGE PRICE PER M
Albany	10	59 517 000	$319 503	$5 37
Columbia	6	57 695 000	284 475	4 93
Dutchess	15	133 229 000	648 151	4 85
Greene	5	28 779 000	139 578	4 85
Orange	6	121 800 000	565 152	4 64
Rensselaer	4	13 352 000	67 760	5 08
Rockland	24	162 400 000	747 040	4 60
Ulster	20	178 287 000	829 035	4 65
Westchester	6	52 654 000	256 449	4 87
Total	96	807 713 000	$3 857 143	$4 78

Output of common brick in the Hudson River region in 1912

COUNTY	NUMBER OF PLANTS	OUTPUT	VALUE	AVERAGE PRICE PER M
Albany	12	69 100 000	$414 600	$6 00
Columbia	5	69 434 000	381 888	5 50
Dutchess	17	122 085 000	665 082	5 45
Greene	6	36 573 000	199 360	5 45
Orange	8	113 363 000	615 155	5 43
Rensselaer	4	13 800 000	82 800	6 00
Rockland	23	191 595 000	1 063 352	5 55
Ulster	21	231 550 000	1 296 779	5 60
Westchester	6	52 844 000	318 422	6 03
Total	102	900 344 000	$5 037 438	$5 60

Hudson River region. Brick manufacture is carried on in the tidewater section of the Hudson river under a uniformity of conditions and on a scale that is unique in this country, if not in the world. The region embraces the nine counties along both sides of the river from Rensselaer and Albany to Manhattan island, to which may be added the proximate portion of New Jersey embraced in Bergen county. The same kind of clay is used throughout with similar methods of treatment, and the product is practically all of one grade which is classed in the market as "Hudson common hard."

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In the nine counties within New York State are included about 125 yards with a capacity of one and one-quarter billion brick in the six or seven months that constitute the average season. So large an output is seldom warranted by the market requirements, however, and the average outturn may be placed at about one billion. The maximum number reported in any recent year was 1,230,000,000 in 1906.

The principal market for the product, of course, is New York and its environs, though some are shipped to the New England towns. Practically the whole output goes by water, on barges which hold upward of 200,000 each and which are made up into a fleet towed by one or more tug boats. In the lower stretch of the river, the shipments from the yards continue throughout the year, whereas the more remote ones have to concentrate their shipments during the months of open water. Formerly the product was handled by several commission agents operating independently and in competition, but in 1911, a general selling agency was established under the title of the Greater New York Brick Company, which now disposes of the output of all but a few yards. The total costs of shipment, storage in New York and commission for sales may be placed at about $1.25 a thousand.

The season of 1912 may be considered a fairly prosperous one with respect to the number of brick marketed and prices, comparing favorably in the latter particular with the preceding year or two. The output was larger than in 1911, but fell considerably below that of 1910 when under the effects of a period of overextended activity, the production far exceeded the market requirements. The surplus of that year amounted to fully 350,000,000 which were carried over into 1911, and which justified a policy of curtailment on the part of manufacturers so as to maintain a closer balance with the market. By thus restricting the outturn, manufacturers were able to maintain prices during 1911 and even to receive somewhat higher returns than the average for the previous year. The opening of the 1912 brickmaking season ranged from the middle to the latter part of May and was delayed about two weeks beyond the average date on account of wet weather. There were about 100,000,000 old brick on hand at that time. Prices started at around $6.50 a thousand, New York basis, or say $5.25 at the yard. They gradually advanced with the progress of the season and reached $7.25 in December. The open weather in the early winter enabled manufacturers to continue shipments much longer than usual, so that the stock in New York was unusually heavy at the first of the year.

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The total number of brick in stock at the yards and in New York on January 1, 1913, is placed according to authoritative information at 312,004,000. The stock on May 1st was 141,204,000. These figures, of course, refer to the stocks which are held for sale in the New York market. A few plants in the more northerly counties sell a part or the whole of their output locally, as those in the vicinity of Albany and Troy, or ship by rail to the interior of the State or to New England.

The total number of brick made in the nine counties along the river last year was 900,344,000. In all, there were 102 yards active. The output at the average selling prices of the year was valued at $5,037,438, or $5.60 a thousand. The total number for 1911 was 807,713,000 valued at $3,857,143 or $4.78 a thousand. The gain in price during the past two years is well shown by comparison with the figures for 1910 when the output was larger than last year's by 200,000,000 but actually fell a little short of the given total value.

Of the several counties, Ulster leads in quantity and value of its product, with a total last year of 231,550,000 valued at $1,296,779. Rockland holds second place, contributing 191,595,000 valued at $1,063,352. Dutchess and Orange counties come next in order with nearly the same output.

OTHER CLAY MATERIALS

The manufacture of vitrified paving brick was carried on by four companies in Cattaraugus, Chautauqua, Erie and Steuben counties, the same number as in 1911. The number of paving brick made was 11,031,000 valued at $174,048, against 18,996,000 valued at $307,529 in the preceding year. The reduced output was caused largely by a shut-down of the plant at Catskill for most of the year, the plant having been taken over by a new company known as the Tidewater Brick Co. The average price of paving brick was $15.78 a thousand, against $16.19 a thousand in 1911.

Fire brick and stove lining were made in Erie, Kings, Rensselaer, Richmond, Washington and Westchester counties and their combined value was $380,005 against $413,500 in 1911. The number of fire brick made was 9,011,000 valued at $327,412. The stove lining was valued at $52,593. There were nine companies in operation, the same number as in the preceding year. Most of the clay employed in the manufacture of the materials comes from outside the State, though the product of Richmond county is made from local clays.

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The output of drain tile was contributed by nine counties, of which Albany had the largest product. The value of the year's manufacture amounted to $122,571 against $202,292 in 1911. Reports were received from 16 active plants, or the same number as reported in the previous year. The value of the sewer pipe produced was $77,644 as compared with $138,258, all from Monroe county.

Fireproofing, including terra cotta lumber, hollow brick and various other kinds of hollow clay ware used for fireproofing, was made last year by six companies with plants situated among the counties of Erie, Kings, Monroe, New York, Oneida and Rensselaer. The total value of the output was $230,833, as compared with $229,627 in 1911 when 7 companies were active. Local clays are employed for these articles.

Building tile, including roofing tile, vitrified floor tile, and terra cotta tile, was reported from Allegany, Kings and Monroe counties by 3 firms. The output had a value of $42,575, against $82,217 in 1911.

Architectural or ornamental terra cotta showed a large increase last year, reaching a value of $1,139,291, as compared with $718,700 in 1911, the largest that has ever been reported. Its manufacture is carried on by 3 companies in Queens, Richmond and Steuben counties.

The miscellaneous clay materials accounted for a value of $13,828, against $20,179 in the preceding year.

POTTERY

The manufacture of pottery has become one of the larger branches of the clay-working industry, showing a steady gain of output during the last several years until it now ranks second only to brick-making in importance. The materials used are mostly brought from outside sources as there are no deposits of white-burning clays suitable for china or porcelain within the State. Feldspar, quartz and stoneware clays, as well as an excellent grade of slip clay, exist in large deposits, but except for slip clay, the local resources are not utilized to any extent for pottery. The recent growth of the home market seems to afford opportunity for development of some of those resources, especially those of feldspar and quartz.

The products of New York potteries include porcelain and china tableware which are made chiefly by the Onondaga Pottery Co.

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and the Iroquois China Co., of Syracuse, the Buffalo Pottery Co., of Buffalo, and the Union Porcelain Works, of Brooklyn. Porcelain electric supplies are manufactured by the Empire China Works, Brooklyn, Locke Insulator Co., with plants at Lima and Victor, Pass & Seymour, Syracuse, General Electric Co., and Weber Electric Co., Schenectady. Chemical and sanitary ware are made by the Chas. Graham Chemical Pottery, Brooklyn. The other products include stoneware, red earthenware, cream-colored ware, clay tobacco pipes, etc.

The total value of the pottery produced last year was $2,876,762, as compared with $2,196,054 in 1911. The electric and sanitary wares accounted for $1,727,553, of which the greater part was represented by the value of the electric supplies. The value of certain metal fixtures is included, however, with that of the electric supplies. China or porcelain tablewares accounted for the next highest total, $1,038,428. The stoneware was valued at $46,024 and red earthenware at $29,697. All other products represented a value of $35,060.

Value of production of pottery

WARE	1910	1911	1912
Stoneware	$41 925	$39 095	$46 024
Red earthenware	25 713	32 495	29 697
Porcelain and semiporcelain [1]	1 027 249	1 048 872	1 038 428
Electric and sanitary supplies	991 131	1 026 517	1 727 553
Miscellaneous	50 500	49 075	35 060
Total	$2 136 518	$2 196 054	$2 876 762

[1] Includes china tableware and cream-colored ware.

CRUDE CLAY

The clay produced in a few localities is not utilized by the original producers, but is shipped to others for manufacture, some of it going to points outside the State. This production, therefore, is listed separately from that of clay materials. The clays most extensively exploited for shipment are the Albany slip clay and the fire clay found on Staten Island. The slip clay is a variety of the ordinary glacial clays found in the Hudson valley in association with the brick clays, differing from the latter in its finer grain and higher content of alkaline constituents. It has a relatively low

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point of fusibility and when applied to clay wares as a slip, produces a rich, brown glaze. Stoneware clays are shipped in a small way from Onondaga county.

The records for 1912 show that the shipments of crude clay in that year amounted to 8583 short tons valued at $18,980. There were 5 producers engaged in this business. The corresponding total for 1911 was 14,193 short tons valued at $11,982. The difference in value indicated by the totals is accounted for by the varying proportions of the higher priced clays, slip and fire clays, included in the statistics for 1912.

EMERY

The emery business, which is confined to a few small operations near Peekskill, has not been very active in the last year or two. The shipments during 1912, as reported by the companies to whom they were made, amounted to 589 short tons, valued at $6479. In 1911 the shipments were reported as 769 short tons valued at $8810, and in earlier years were still larger, reaching as high as 1500 tons at one time.

The Peekskill emery is a hard, dense rock of rather variable composition and dark gray to black color. It occurs in small lenses, bands and irregular masses in the area of basic igneous rocks that outcrops south and east of Peekskill. The emery bodies are found mainly in the northern section of the area and apparently near the contact of the igneous, or Cortlandt, series with the sedimentary schists. They represent without much doubt segregations within the intrusive mass similar to the titaniferous magnetites that occur within the gabbros and anorthosites of the Adirondacks. The surrounding sediments may have been absorbed more or less into the igneous mass on its way to the surface, thereby contributing some of the aluminum which has crystallized out in the form of corundum and spinel. The intrusion took place after the deposition of the Hudson River strata which are made up largely of argillaceous materials.

The emery is a mixture of corundum, spinel and magnetite, with more or less of the silicate minerals that are found in the wall rocks. The proportion of the oxids varies greatly. In some places magnetite constitutes nearly the whole mass and such bodies have been worked in the past for their iron, though not with much success. Spinel (hercynite) is intimately associated with the magnetite, though its presence is seldom to be established without microscopic examination, being in finely divided particles scarcely distinguishable

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from the latter in the hand specimens. Its occurrence may account for the high aluminum percentages shown in analyses of the magnetites, even in the absence of corundum. The latter is a fluctuating constituent, constituting as much as 50 per cent of the emery in places, but usually considerably less. It appears in the form of thin prismatic crystals which are set off by reason of their light color and their relatively large size from the magnetite and spinel.

The mines consist of open cuts on the outcrop of the bodies, occasionally supplemented by a single underground level reached through an adit. They have little permanent equipment, being too small to warrant any considerable outlay for machinery; consequently there is a lack of stability and system to the operations.

The present source of supply is mainly from one or two properties on the northern border of the Cortlandt area. The Keystone Emery Mills and the Blue Corundum Mining Co. have been the principal shippers of recent years. There are a number of mines in the section north of Dickinson hill and south of the east-west highway leading out of Peekskill, but most have been closed either on account of exhaustion or the unsuitable character of the material. Some of the more extensive workings are on the farms of John Buckbee and Oscar Dalton.

FELDSPAR

Feldspar is one of the minor products for which the market in this section hitherto has been rather limited. The pottery trade in which the better or more valuable grades find use has only recently come into prominence in New York, and the larger centers without the State, as those of Ohio, West Virginia and New Jersey, can usually be supplied more cheaply from other sources. Thus the principal quarries of pottery spar are found in New England, the Southern States and Canada. The local quarries in the Adirondacks and the southeastern metamorphic belt have never been able to compete very successfully in this branch of the business.

With the recent growth of the pottery business, now represented in many branches and in various parts of the State, there would seem to be opportunity for development of some of these resources to meet the requirements of the local market.

The uses of feldspar, aside from that of pottery manufacture, are sufficiently varied to afford a basis for regular quarry operations such as are carried on at present. One of the principal applications is in the preparation of roofing material, where it is

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employed as a surface coating with tar or some bituminous binder. The spar is crushed to pea size or a little coarser and by reason of its good cleavage yields flat surfaces that are of advantage in securing firm adherence. The purity of the material, however, is a subordinate factor; the pegmatite which contains more or less quartz, mica and other minerals, is crushed down to size just as it comes from the quarry. Besides the roofing grades, there is more or less fine material resulting from the crushing, which is sold for use in concrete and grout. A small quantity of the spar of the coarser size is sold for poultry grit. Crushed pegmatite for these purposes brings a low price, usually around $3 a ton.

The quarries and mills making roofing spar are situated in the Adirondack region, and include those of the Crown Point Spar Co. at Crown Point and the Barrett Manufacturing Co. at Ticonderoga. The methods of milling are simple, being based on a system of gradual reduction and sizing by screens. For the first step, a coarse crusher of the Blake type may be used, followed by rolls. At the mill of the Crown Point Spar Co., a higher grade of spar that is sold to enamel ware manufacturers is made by crushing to fine size in a chaser. The spar is first sent to the Blake machine, is then dried and instead of passing through the rolls, goes to the chaser.

Manufacturers of enamel ware, glazed brick and terra cotta consume considerable quantities of feldspar. The requirements for these purposes are more exacting than for ordinary roofing spar in that the material must be fairly free of iron or iron-bearing minerals and have a relatively low point of fusibility. The feldspar should also be fairly free of admixture with quartz, as the presence of the latter tends to raise the melting point. As soda feldspar or albite fuses at a slightly lower temperature than the potash varieties orthoclase and microcline, it has preference among the glazed brick and terra cotta manufacturers. The spar is prepared by fine grinding by a chaser or a pebble or ball mill, the operations in a pebble mill lasting about 5 hours and reducing the product to a size that over 90 per cent will pass a 100-mesh screen. The glaze is added to terra cotta by dipping or spraying with the prepared slip and then burning in a kiln.

Another use for the local product is in the manufacture of opalescent glass. This requires a spar of about the same quality as that for enamel ware, but may contain more quartz. The material is also ground to about the same size.

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A considerable quantity of feldspar is employed as an abrasive, especially in the form of scouring soaps and powders. It is not readily apparent, however, why feldspar should be preferred to quartz for the purpose, unless it is on account of the cleavage which may, like the parting of garnet, provide sharp cutting edges. For scouring materials, the spar is ground to an impalpable powder. Feldspar is also an ingredient of emery, carborundum and corundum wheels, but here it serves rather as a binder than as an abrasive.

The output of feldspar showed a very large gain in 1912. In former years, it has ranged between 10,000 and 15,000 tons, according to the relative market conditions which were fairly stationary. Last year, however, it reached a total of 24,584 short tons, an increase of over 50 per cent in the twelve months, and in value amounted to $106,419. These figures include the unsorted pegmatite that is used for roofing material as above explained. The increase was contributed mostly by the Bedford Feldspar Co., which began operations during the year near the Kinkel quarries. The prices received for the product were on about the usual level: $3 a ton for sized roofing spar, $4.50 a ton for selected crude, and $6 to $8 for the ground spar used for enamel, glass manufacture, etc.

The Bedford Feldspar Co. opened a quarry just north of the Kinkel quarries at the base of the hill that marks the main outcrop of the pegmatite body. The continuation of the pegmatite in this direction was shown by drilling, being covered by soil and earth to a depth of about 15 feet. The present opening consists of a circular pit about 75 feet in diameter and 30 feet deep. A derrick is used to raise the rock to the surface. The pegmatite is somewhat stained and disintegrated in the upper part, but doubtless fresher material will be found in depth. It seems to carry more feldspar and less quartz than the average run of the rock exposed in the Kinkel quarries. The company has a mill at the quarry and all the output is shipped in ground state, to tile, enamel ware and glass manufacturers. The mill is equipped with ball mills and has a capacity of 35 or 40 tons a day.

The Kinkel quarries were operated during the year, but the product was shipped in crude form. The mill has been partly dismantled for the installation of new machinery, which will include pebble mills for the preparation of pottery spar. A considerable quantity of the no. 1 potash spar is stocked at the quarries until grinding can begin. The usual shipments of quartz were made from

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these quarries to the Bridgeport Wood Finishing Co., for use as wood filler. In addition, Kinkel & Son grind some quartz at a mill south of the quarries.

The latter company opened a new quarry in the spring of 1912, on the Bullock property, 2 miles south of the Bedford quarries. The opening lies west of the Hobby quarry on a parallel lens or dike. The pegmatite body measures about 30 feet in thickness, strikes northeast and dips 80° northwest. The wall rock as seen near the contact is a mica schist resembling the Manhattan schist farther south. The opening into the hill is about 75 feet long and shows a face 30 feet high. It can be deepened considerably without difficulty, as the present level lies near the summit of the hill. The feldspar differs from the Bedford varieties in that it is practically all of buff or cream-color and is shown by microscopic examination to consist of an intergrowth of microline and albite. The two kinds form alternating bands with the microline predominant, in the proportion of 2 or 3 to 1. In the Bedford quarries, the two varieties are segregated into a red microline and a white albite. There is very little intergrowth of feldspar and quartz and most of the product is shipped as no. 1 grade. The feldspar builds crystals that measure up to 2 or 3 feet in diameter and which occasionally show well-defined faces. The quartz is of smoky appearance. There is some muscovite in their scales and sheets associated with the feldspar, but it is mostly segregated. A black tourmaline and dark red garnet are among the accessory constituents.

GARNET

The production of abrasive garnet in the Adirondack region has continued from year to year with little change. The annual total usually is between 4000 and 5000 short tons, now and then slightly exceeding the latter figure. This seems to indicate a fairly stable market which affords the basis for a small and somewhat specialized industry, but which could hardly accommodate any large additional supplies of the mineral, as have been in prospect at different times, without radical readjustment of the present conditions. So far, no permanent or serious competition has developed as the result of mining operations in other sections of the country. For the last few years, however, there has been an importation of Spanish garnet which fills some of the requirements formerly met by the local product.

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The active mines in the Adirondacks are situated in Essex and Warren counties. The North River Garnet Co., with mines and mill on Thirteenth lake, Warren county, southwest of North River, is the principal producer and carries on operations more or less continuously throughout the year. The garnet occurs in disseminated crystals in a hard, gneissoid hornblende — feldspar rock which has to be crushed and subjected to mechanical separation to recover the mineral, the separation being complicated by the slight difference in the gravity of the garnet and hornblende. The separation is effected mainly by jigs of special design and results in a very clean concentrate, with such variation of sizes as is required for abrasive purposes. The deposit, situated on the side of a mountain, is attacked by open-cut quarry methods which by reason of its large size and convenient position admit of great economy in breaking and transporting the rock.

The next most important source of garnet is on Gore mountain, a little west and south of North Creek, and some 4 or 5 miles southeast of the former deposit. The garnet here occurs in a band of dark hornblende gneiss, forming larger crystals than are found anywhere else in the Adirondacks. They measure a foot or even more in maximum diameter. The band of garnet gneiss is relatively narrow and is worked in open pits. The rock is broken down by sledges and the garnet, which has been shattered by regional compression, is readily picked out of the matrix by hand. These quarries are worked only in the open season. They are operated by H. H. Barton & Son Co. of Philadelphia.

Some production has been made from time to time from Garnet peak, in the town of Minerva, Essex county, about 3 miles from North River, on the Indian Lake road. The garnet is in small srystals, but plentifully distributed through the rock. In years past the American Glue Co. has been active at this locality, but made no output in 1912.

The Warren County Garnet Mills, Inc., of Riparius, have recently been active at a locality near Wevertown, south of North Creek. The mineral here is quite different in appearance from that produced in the other mines of this section, being partly granular or compact, rather pale in color, and lacking the tendency to break with smooth surfaces which is characteristic of the crystal garnet. It is also more or less intergrown with a green pyroxene. The material is hand-sorted and prepared for market by grinding to proper size.

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Outside the rather limited area that includes the above named localities, the only occurrence of garnet that has recently attracted attention as a basis of mining operations is in northern Essex county, a few miles south of Keeseville. The deposits lie on Mt Bigelow, near the border but within the area of anorthosite — the basic igneous rock that forms the central part of the Adirondacks. They consist of bands, lenses and irregular bunches of granular or seemingly massive garnet which is fairly pure, except for inclusions of green pyroxene. They are inclosed directly within the anorthosite. Some of the bands or lenses as seen on the surface are 40 feet across, nearly solid garnet. They are worked in a rather small way by the American Garnet Co. of New York. A similar deposit is reported from the vicinity of Mt Pokamoonshine, southwest of Mt Bigelow.

The production of garnet by the different mines in the Adirondack region amounted last year to 4112 short tons valued at $117,325, as compared with 4285 short tons valued at $121,759 in 1911. These totals represent practically the extent of the industry in this country. Imports of abrasive garnet were reported by the collectors of customs at Boston and New Orleans, at which ports 548 tons valued at $9271 were received in the calendar year. The imports for 1911 were 693 short tons, with an invoice value of $10,526. With the exception of a small shipment of 1200 pounds from Nova Scotia, probably originating in Newfoundland, the garnet was all imported from Spain.

GRAPHITE

The graphite mines in the Adirondacks last year contributed about the usual product of refined crystalline graphite, but there were fewer developments than for some time. The output was 2,628,000 pounds and represented a value of $142,665. The total for 1911 was 2,510,000 pounds with a value of $137,750. There was little change in prices, the average having been 5.4 cents a pound, against 5.5 cents in 1911.

The American mine at Graphite, owned by the Joseph Dixon Crucible Co., continued as the main producer. This mine has had an enviable record, and is still the most successful of its kind in the State or in this country; it has been the pioneer in all that relates to the technology of treating the disseminated flake graphite which constitutes the principal source of the domestic production.

The Empire Graphite Co., with mines and mill in the town of

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Greenfield, Saratoga county, made a small output which was obtained mainly from development work. The deposit has not been sufficiently opened to permit regular operations. At first the company attempted to secure an ore supply by open-cut methods, but owing to the decomposed condition of the outcrop the material thus obtained was unsuited for milling. During the past year an incline shaft was started to develop the deposit in depth. The company has a large concrete mill on the property.

The Saratoga Graphite Co. began operations last season in its mines near Kings Station north of Saratoga Springs.

The mines are open cuts along the outcropping edges of a quartz-graphite schist which occurs in broken areas within the Precambric formations that are otherwise represented by crystalline limestone, quartzite, amphibolite and gneissoid eruptives of granitic and basic character. They lie about one-half mile west of the Saratoga-Mt McGregor highway on the side and top of the ridge that marks the eastern boundary of the Precambrics as they fall off and disappear below the Paleozoic strata which border the Adirondack area. The first outcrop of the graphite rock on the north side of the ravine in which the mill is located shows from 10 to 12 feet in a single bed. The outcrop is much softened and iron stained through the decomposition of pyrite that is present in the fresh rock. This soft clayey material is of little value for milling purposes. The bed dips 30 degrees southeast, nearly parallel with the hill slope. The open cut is 50 feet long and 25 feet in width. Specimens of the less altered schist show an abundance of graphite, but in finely divided condition, most of the scales being less than 1 millimeter diameter. There is some brown mica present. About one-fourth mile farther west and higher up, a second area of the schist appears and has been opened by a pit which is 75 feet long by 30 feet in width. The schist here is not so thinly laminated and contains knots and stringers of feldspar. The beds dip to the southeast at a lower angle than in the easterly pit; they have a pitch to the northwest. The graphite here is somewhat coarser, the diameter of the flakes running up to 2 or 3 mm. The two areas are separated by a rather massive, dark hornblende gneiss that appears to be a metamorphosed gabbro. The output of refined graphite thus far has been small. The mill has the usual equipment of the Adirondack graphite mills. Stamps are used for final crushing and the separation is effected mainly by buddles, supplemented by air jigs and revolving screens for the final treatment.

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GYPSUM

There was a noticeable, if not marked, improvement in the gypsum industry last year, as compared with the conditions noted in the preceding issue of this report. The market for gypsum and its products in 1911 was considerably depressed, and instead of showing the usual gain as for previous years, production fell below the total reported for 1910. The main reason for the dulness was the lessened activity in the building trades and the consequent smaller demand for wall plasters, the principal product of the local industry. The companies also reported a falling off in shipments of crude rock, of which the main item is represented by the sales to the portland cement plants and is second in importance only to the consumption by the calcining mills. In both these departments some betterment was apparent during the past season, not only with respect to the demand, but also to some extent in the prices received for the products. The gain came mostly in the latter part of the year and was well maintained to the close. The outlook at the beginning of the current year seemed favorable for the continuance of an active market, at least for the first part of the season.

The output of crude rock by the mines and quarries last year amounted to 506,274 short tons. This was the largest total on record; the next largest was in 1910 when it amounted to 465,591 short tons. In 1911, the output was reported as 446,794 tons. The increase for the year, therefore, was 59,480 tons or about 13 per cent.

The greater part of the output, as heretofore, was used at the mines for the manufacture of stucco and wall plaster. Most of the mining companies operate their own plants for milling and calcining the rock, their output entering the market only in finished form. A few, however, dispose of a part of their product in crushed or ground condition without further preparation, and one company ships all its rock in that form. The portland cement plants of New York, Pennsylvania and New Jersey take most of the raw gypsum, but some is shipped to plate glass manufacturers for bedding the glass sheets in polishing, and a small quantity is sold in ground form for agricultural uses. As it would be difficult to place a value on the rock that is manufactured directly by the producing companies, the plan has been adopted of reporting the total value in terms of the several products as they are marketed. Of the output last year, a total of 178,499 short tons was sold or held for sale as crude rock, as compared with 144,035 short tons thus

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sold in 1911. The value of the rock was $240,784 against $202,984 for the preceding year. The quantity ground for land plaster was 8213 short tons with a value of $17,779; as compared with 9959 short tons valued at $18,508 in 1911. The remainder represented approximately the amount calcined for stucco and wall plaster, of which the product amounted to 267,889 short tons valued at $928,282. The corresponding total in the preceding year was 262,249 short tons with a value of $871,106. The total value of the marketable products for the year thus amounted to $1,186,845 as compared with $1,092,598 in 1911.

Production of gypsum

MATERIAL	1911		1912	
	SHORT TONS	VALUE	SHORT TONS	VALUE
Total output, crude	446 794	.....	506 274	.....
Sold crude	144 035	$202 984	178 499	$240 784
Ground for land plaster	9 959	18 508	8 213	17 779
Wall plaster, etc. made	262 249	871 106	267 889	928 282
Total	.....	$1 092 598	.....	$1 186 845

The production of crude rock was contributed by relatively few companies, about ten in all, and was divided among the four counties of Onondaga, Monroe, Genesee and Erie. While in earlier years most of the output was made in the eastern section in Madison, Onondaga and Cayuga counties, by far the greater proportion now comes from the western deposits which are the basis of a prosperous calcining industry. The mines of that section rank with the largest and best equipped of their kind in the country.

In Onondaga county the output has fallen off in recent years, owing to the decline in the land plaster business, to which there has succeeded no commensurate development of other branches. Only one or two quarries are now operated out of the number that have been opened along the extensive outcrop of the beds. The present supply is derived from the vicinity of Lyndon, and mainly from the Severance quarry which has been worked by the Fayetteville Gypsum Co., for supply of rock to calcined-plaster works in New York. The rest of the output from this section was used locally by the land plaster mills at Fayetteville and Jamesville.

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The large quarries at Union Springs, Cayuga county, were not active in 1912, but have recently been taken over by the Cayuga Lake Portland Cement Co. for supply of gypsum to their works at Portland Point, near the southern end of Cayuga lake. After pumping out the quarry pit in the spring, active shipments were begun about June 1st. The gypsum is rather low grade, but constitutes such a thick series of beds that it can be extracted very cheaply, and the situation is convenient for shipment to the portland cement plants of eastern Pennsylvania. The rock is taken from the quarry to a mill at the lakeside when it is crushed and loaded into cars.

The mines of Monroe county increased their production during the year, but there was little change otherwise in that section. The county ranked second to Genesee in quantity of rock mined. About two-thirds of the total was calcined at the mines and the rest sold crude to portland cement makers, or ground to land plaster. The Lycoming Calcining Co., the Consolidated Wheatland Plaster Co., and the Empire Gypsum Co. operated calcining plants, while the Oatka Gypsum Co. sold all its output in crude form.

At Mumford, the Delac Gypsum Products Co. did some prospecting and started construction work on a mill for the manufacture of the calcined plasters. The company secured options on the M. Skivington farm north of Mumford, where five test holes were drilled, in all of which gypsum was found. A hole located near the southern end of the property on the flat along Allen creek gave the following section, according to records in possession of Mr Skivington:

Material	Feet	Inches
Surface materials	8	6
Limestone	2	–
Ashes (shaly gypsum)	1	6
Rock	7	–
Gypsum and ashes	3	8
Limestone and ashes	9	4
Gypsum	2	–
Limestone	6	–
Gypsum	5	6
Limestone	8	–
Gypsum	5	–
Limestone	6	–
Ashes	1	6
Gypsum	4	6
Limestone	3	6
Gypsum	4	6
Limestone and ashes	2	6
Gypsum	2	–
Limestone and ashes	2	–
Total depth	85	–

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The succession is scarcely comparable with that at Garbutt, the center of the mining industry in this part of the field, where the gypsum rock occurs in two beds, each from 5 to 8 feet thick, separated by a bed of limestone ranging from 6 to 12 feet in thickness.

The principal development in the Oakfield district, Genesee county, was the construction of a new calcining plant by the United States Gypsum Co. The plant has five vertical kettles, a very important addition to the manufacturing capacity of the company already the largest in the State.

On the extreme section of the gypsum belt, near Akron, the American Gypsum Co. maintained its usual operations, but the Akron Gypsum Co. closed its mines and plaster works in the fall. The existence of gypsum to the west of Akron was reported to have been proved by test holes; the discovery has not been succeeded as yet by any developments. A hole put down in the foot wall of the seam at Akron to a depth of 70 feet failed to show any workable deposit, though farther east, in Monroe county, two distinct beds are known to occur.

IRON ORE

Iron mining in the State resulted in about the same output last year as in 1911. There was a better inquiry for ore than the market showed during most of the year before, but prices were not correspondingly higher to furnish the necessary incentive to enlarged operations. No new mines entered upon the producing stage. Exploration and development work, however, continued active, specially in the Adirondack region, and brought to light substantial additions to the resources that eventually should be turned to account.

The production of iron ore during the last two decades is given in the accompanying table. The figures are based on lump ore and concentrates of commercial grades, and not on the mine output, which, by reason of the large proportion that is subjected to mill treatment, is considerably larger. The figures for ten years previous to 1901 have been taken from the volumes of the *Mineral Resources*, and the others compiled from reports submitted by mining companies.

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Production of iron ore in New York State

YEAR	MAGNETITE	HEMATITE	LIMONITE	CARBONATE	TOTAL	Total value	Value a ton
	Long tons	Long tons	Long tons	Long tons	Long tons		
1892	648 564	124 800	53 694	64 041	891 099	$2 379 267	$2 67
1893	440 693	15 890	35 592	41 947	534 122	1 222 934	2 29
1894	.....	.....	.....	.....	242 759	.....	.....
1895	260 139	6 769	26 462	13 886	307 256	598 313	1 95
1896	346 015	10 789	12 288	16 385	385 477	780 932	2 03
1897	296 722	7 664	20 059	11 280	335 725	642 838	1 91
1898	155 551	6 400	14 000	4 000	179 951	350 999	1 95
1899	344 159	45 503	31 975	22 153	443 790	1 241 985	2 80
1900	345 714	44 467	44 891	6 413	441 485	1 103 817	2 50
1901	329 467	66 389	23 362	1 000	420 218	1 006 231	2 39
1902	451 570	91 075	12 676	Nil	555 321	1 362 987	2 45
1903	451 481	83 820	5 159	Nil	540 460	1 209 899	2 24
1904	559 575	54 128	5 000	Nil	619 103	1 328 894	2 15
1905	739 736	79 313	8 000	Nil	827 049	2 576 123	3 11
1906	717 365	187 002	1 000	Nil	905 367	3 393 609	3 75
1907	853 579	164 434	Nil	Nil	1 018 013	3 750 493	3 68
1908	663 648	33 825	Nil	Nil	697 473	2 098 247	3 01
1909	934 274	56 734	Nil	Nil	991 008	3 179 358	3 21
1910	1 075 026	79 206	4 835	Nil	1 159 067	3 906 478	3 37
1911	909 359	38 005	5 000	Nil	952 364	3 184 057	3 34
1912	954 320	103 382	Nil	Nil	1 057 702	3 349 095	3 17

The output in 1912, as reported by all the mines that made shipments during the year, was 1,057,702 long tons, valued at $3,349,095. Compared with the total for the preceding year, there was a gain of 105,338 tons, or about 10 per cent, as against a decline of 206,703 tons in 1911. The value of the ore averaged $3.17 a ton, as against $3.34 for 1911; the falling off indicated by these figures was not solely a market decline, but was due in part to the large proportion of hematite shipped during the past year.

Of the output, magnetite constituted a total of 954,320 long tons and represented a value of $3,148,756. The quantity of hematite mined was 103,382 long tons, all from the Clinton belt, with a value of $200,339. There were no shipments of limonite ore from southeastern New York and none of carbonate, although these were actively mined a few years ago.

The output of magnetite was made up largely of concentrates, some of the mines in the Adirondacks shipping all their product in that form. A ton of concentrates, which on the average contains about 65 per cent iron, represents all the way from a little over one to three tons of crude ore. The actual amount of magnetite raised from the mines during the year was 1,174,295 long tons; and the total quantity of ore of all kinds hoisted was 1,277,677. In 1911 the total quantity hoisted was 1,258,873 tons.

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The list of companies that were active in the industry last year included for the Adirondack region: Witherbee, Sherman & Co. and the Port Henry Iron Ore Co., Mineville; Cheever Iron Ore Co., Port Henry; Chateaugay Ore & Iron Co., Lyon Mountain; Salisbury Steel & Iron Co., Salisbury Center; and the Benson Mining Co., Benson Mines. The producers of magnetite in southeastern New York were the Hudson Iron Co., Fort Montgomery, and the Sterling Iron & Railway Co., Lakeville. The output of hematite was made by C. H. Borst, Clinton; Furnaceville Iron Co., Ontario Center; and Ontario Iron Ore Co., Ontario Center.

Mineville. The product of the mines at Mineville, the most important center of the industry, was a little below that reported in 1911, in actual figures 675,512 long tons against 734,353 long tons in 1911. Operations were conducted in the same mines as in the preceding year, including the Old Bed, Harmony and Barton Hill groups of Witherbee, Sherman & Co. and 21 and Welch shafts of the Port Henry Iron Ore Co.

The principal feature of the year's record of developments, perhaps, has been the progress of underground and surface work on the Barton Hill properties, as a result of which they have again resumed active production. These mines have contributed a considerable output of high-grade ore in the past, but for many years were neglected on account of the difficulties presented by their somewhat isolated position and irregularity. These difficulties have now been removed to a considerable extent by the driving of a tunnel on the course of the ore and well below the outcrop, which gives access to the lower part of the ore zone and provides an easy haulage way as well as natural drainage for ground above its level; and by the erection of an independent concentrating plant on the side of the hill to treat the output. The mill is the fourth of the series erected by Witherbee, Sherman & Co.; one of the others being erected on the Harmony mines and the two older ones on the Old Bed group.

Cheever mine. The operations at Cheever mine, just north of Port Henry, continued to afford a considerable output of concentrating ore, mainly from the southern section. Some bands of high-grade magnetite have also been encountered, but the main dependence is the leaner material left in the walls in the previous period of activity. The management has been very successful in dealing with the problems incident to the restoration of the old underground workings and in the treatment of the ore on the sur-

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face; and though not so large as some of the other Adirondack mines measured by output, the property is technically in the front rank. The surface equipment has been enlarged during the past year by the erection of a storage bin at the foot of the cable road on which the concentrates are lowered to the railroad for shipment.

Ausable Forks. Exploration of the magnetite bodies in the vicinity of Ausable Forks has been under way recently, with substantial results. The work was first directed to the old mines on Cook hill at Arnold where the ore zone has been tested by the diamond drill and by surface excavations for a long distance. A very large tonnage of concentrating ore is now known to exist there. In 1912 operations were conducted in the region to the north of Ausable Forks, beyond the Palmer Hill and Jackson Hill mines, an outlying field that hitherto has received little attention. A well-defined zone consisting of lenses or bands of magnetite arranged in series has been found to exist, a parallel occurrence to that on Cook hill. Of geological interest is the development locally of apatite-rich magnetites that recall the Old Bed ores at Mineville. On the northeastern end of the zone the lenticular or tabular form is less apparent, the bodies showing rather irregular shapes as seen on the surface, and the magnetite is in places a filling or cement to brecciated portions of the syenitic country rock.

Benson Mines. The production by the mines at Benson Mines was limited to experimental runs made for the purpose of testing out the new mill equipment. The plant has been largely rebuilt so as to make it more representative of current practice, and storage capacity provided for 10,000 tons of crude ore in order to insure better conditions of operation during the winter months. The company has also erected a power plant on the Oswegatchie river and will hereafter operate the mines and mill by electricity.

Southeastern New York. In the Highlands district the Hudson Iron Co. and the Sterling Iron and Railway Co. were the only operative companies and each contributed its normal quota.

A new enterprise was started during 1912 on the east side of the Hudson, back of Garrison in Putnam county. The Mt Summit Ore Corporation began exploratory work on a property that up to that time had remained practically undeveloped, though reported as belonging once to the Kingston Iron Ore Co. This property lies on the road to Tompkins Corners, high up on the ridge between the Hudson and the small valley occupied by Sprout brook. The ore is magnetite of granular to compact massive character and

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occurs in seams interbanded with the county gneiss; also in disseminated particles through the mass of the rock. The seams, of which the heaviest is 4 or 5 feet thick, are rich in places, but the general run, as shown by the accumulation of material on the surface, is of considerably lower grade. There is little to be seen in outcrop, as in fact exposures in that vicinity are quite limited. The county rock appears to be a laminated biotite-hornblende gneiss that has undergone injection by granite so as to exhibit as much of the latter as of the original mineral aggregate. The granite develops frequently a pegmatitic texture and is accompanied by bands of white vein quartz. The ore seams, with the included rock containing disseminated magnetite, conform in strike and dip. The latter at the surface is about 45° northwest but is said to become nearly vertical at the bottom of the prospecting shaft, which had reached a depth of 165 feet in June 1913. The strike is northeast with the prevailing trend of the Highlands Precambric formations. The company has erected a mill on the property for the purpose of concentrating the ore. The building is of sheet iron and is equipped with crushers, a dryer and magnetic separators. The latter are of the permanent magnet type, said to be a modified form of the Carter apparatus. The ore crushed down to 1.5 inch size, or less, falls in a thin stream in front of the horizontal magnets arranged one above another; the magnetite is diverted from the normal direction of fall by the attraction and passes into a separate receptacle, while the tailings continue their course downward from magnet to magnet without deflection. This method has the objection that the very fine particles of gangue are entangled more or less with the magnetite, as there is no jar or jigging movement to aid in their separation, which is secured by the common types of the drum and belt machines used in the Adirondack mills. To obviate this difficulty it is proposed to equip the last of the series of separators with an air-suction apparatus to draw off the dust from the falling stream of ore and tailings.

MINERAL WATERS

New York has held for a long time a leading position among the states in the utilization of mineral waters. The different springs, of which over two hundred have been listed as productive at one time or another, yield a great variety of waters in respect to the character and amount of their dissolved solids. There are some that contain relatively large amounts of mineral ingredients and

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are specially valuable for medicinal purposes; Saratoga Springs, Ballston Springs, Richfield Springs, Sharon Springs and Lebanon Springs are among the more noted localities for such waters. Numerous other springs are more particularly adapted for table use containing only sufficient mineral matter perhaps to give them a pleasant saline taste. Both kinds of waters are generally carbonated and sold in small bottles.

Of late there has developed an important business in the sale of spring waters which can hardly be classed as mineral in the common acceptance of the word, but which are extensively consumed for office and family use in the larger towns and cities. Their employment depends upon their freedom from harmful impurities, in which feature they are generally superior to the local supplies. In so far as such waters are an article of commerce they may well be included in a canvass of the mineral water industry. They are usually distributed in large bottles or carboys in noncarbonated condition.

Character of mineral waters. Among the spring waters that contain mineral ingredients in appreciable quantity those characterized by the presence of alkalis and alkaline earth are the most abundant in the State. The dissolved bases may exist in association with chlorin and carbon dioxid, as in the springs of Saratoga county, or they may be associated chiefly with sulphuric acid, as illustrated by the Sharon and Clifton springs.

The mineral waters of Saratoga Springs and Ballston are found along fractured zones in Lower Siluric strata, the reservoirs occuring usually in the Trenton limestone. They are accompanied by free carbon dioxid which, together with chlorin, sodium, potassium, calcium and magnesium, also exists in dissolved condition. The amount of solid constituents in the different waters varies from less than 100 to over 500 grains per gallon. Large quantities of table and medicinal waters are bottled at the springs for shipment to all parts of the country. The carbon dioxid which issues from the wells at Saratoga is likewise an important article of commerce.

The waters at Richfield Springs contain the elements of the alkali and alkaline earth groups together with sulphuric acid and smaller amounts of chlorin, carbon dioxid and sulphureted hydrogen. They are employed for medicinal baths as well as for drinking purposes. The springs issue along the contact of Siluric limestone and Devonic shales. Sharon Springs is situated to the east of Richfield Springs and near the contact of the Lower and Upper Siluric. Clifton

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Springs, Ontario county, and Massena Springs, St Lawrence county, are among the localities where sulphureted waters occur and are utilized.

The Oak Orchard springs in the town of Byron, Genesee county, are noteworthy for their acid waters which contain a considerable proportion of aluminum, iron, calcium and magnesium, besides free sulphuric acid.

The Lebanon spring, Columbia county, is the single representative in the State of the class of thermal springs. It has a temperature of 75° F. and is slightly charged with carbon dioxid and nitrogen.

Ordinary spring waters. The greater quantity of spring waters consumed in the State belongs to the nonmedicinal, noncarbonated class, represented by such springs as the Great Bear, Deep Rock, Mount View, Sun Ray, Chemung etc. The waters are obtained either by flowing springs or from artesian wells and are shipped in carboys or in tank cars to the principal cities where they are bottled and distributed by wagons among the consumers. The essential feature of such waters is their freedom from noxious impurities. This is generally safeguarded by the care exercised in the handling of the waters which are also regularly examined in the chemical and bacteriological laboratories.

Carbon dioxid. This gas is given off in quantity by some of the wells at Saratoga Springs, and its collection and storage for shipment constituted for many years an important industry at that place. Over 30 wells have been bored there for gas alone. The industry has now been discontinued by force of a legislative enactment; it was considered that the pumping of the wells for the production of the gas was detrimental to the other springs that were utilized solely for their waters. For some time the value of the natural gas secured from the wells exceeded that of the mineral water sales.

List of springs. The following list includes the names and localities of most of the springs in the State that are employed commercially, as shown by a canvass of the industry:

NAME	LOCALITY
Baldwin Mineral Spring	Cayuga, Cayuga co.
Coyle & Caywood	Weedsport, Cayuga co.
Diamond Rock Spring	Cherry Creek, Chautauqua co.
M. J. Spicer	West Portland, Chautauqua co.
Breesport Oxygenated Mineral Spring	Breesport, Chemung co.
Chemung Valley Spring	Chemung, Chemung co.
Keeseville Mineral Spring	Keeseville, Clinton co.
Lebanon Mineral Spring	Lebanon, Columbia co.
Mt Beacon Spring	Matteawan, Dutchess co.

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NAME	LOCATION
Mount View Spring	Poughkeepsie, Dutchess co.
Ayers Amherst Mineral Spring	Williamsville, Erie co.
Elk Spring Water Co	Lancaster, Erie co.
Beauty Spring Water Co	Lyons Falls, Lewis co.
Mohawk Springs	Amsterdam, Montgomery co.
Cold Spring	New York Mills, Oneida co.
Lithia Polaris Spring	Boonville, Oneida co.
Orville Risley	Whitesboro, Oneida co.
J. Wells Smith	Franklin Springs, Oneida co.
F. H. Suppe	Franklin Springs, Oneida co.
Geneva Lithia Spring	Geneva, Ontario co.
Red Cross Lithia Spring	Geneva, Ontario co.
Crystal Spring	Oswego, Oswego co.
Great Bear Spring	Fulton, Oswego co.
Os-we-go Spring	Oswego, Oswego co.
Mammoth Spring	North Greenbush, Rensselaer co.
Shell Rock Spring	East Greenbush, Rensselaer co.
Madrid Indian Spring	Madrid, St Lawrence co.
Massena Mineral Spring	Massena Springs, St Lawrence co.
Artesian Lithia Spring	Ballston Spa., Saratoga co.
Comstock Mineral Spring	Ballston Spa., Saratoga co.
Arondack Spring	Saratoga Springs, Saratoga co.
Geyser Spring	Saratoga Springs, Saratoga co.
Gurn Spring	Saratoga Springs, Saratoga co.
Chalybeate Spring	Sharon Springs, Schoharie co.
Eye Water Spring	Sharon Springs, Schoharie co.
Gardner White Sulphur Spring	Sharon Springs, Schoharie co.
Sulphur-Magnesia Spring	Sharon Springs, Schoharie co.
Red Jacket Spring	Seneca Falls, Seneca co.
Pleasant Valley Mineral Spring	Rheims, Steuben co.
Setauket Spring	Setauket, Suffolk co.
Elixir Spring	Clintondale, Ulster co.
Sun Ray Spring	Ellenville, Ulster co.
Vita Spring	Fort Edward, Washington co.
Briarcliff Lodge Association	Briarcliff Manor, Westchester co.
Gramatan Spring Water Co	Bronxville, Westchester co.

Production. The returns made by the spring water companies for 1912 showed sales of 9,682,447 gallons valued at $760,847. In the preceding year the sales amounted to 8,923,628 gallons valued at $756,147. There was thus a considerable gain in quantity but a very slight advance in value of the output, which may be attributed to the continued increase of the sales of nonmedicinal or fresh waters over the higher priced carbonated waters. The values as given are based on the wholesale prices at the spring localities, exclusive of the cost of bottling. No account is made of the waters used in hotels, sanitariums etc., run in connection with the springs, though this is an important item in the business in some places. The number of springs used for commercial purposes has declined during the past year or two owing to the inclusion of nearly all the important Saratoga wells in the new State reservation. Several of the wells have been thrown open to public use, but are not utilized for the sale of bottled waters.

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Saratoga Springs. The commercial production of carbon dioxid, formerly an important product from the wells at Saratoga, has ceased altogether, as a result of the legal proceedings recently taken against the companies operating wells for the purpose. The lands of these companies also have now been incorporated in the State reservation. Of the large number of springs once so used for gas or for the sale of bottled waters, only a few, like the Arondack, Vichy and Gurn, are still held in private hands. The report of the Commissioners of the State Reservation, submitted in March 1913, indicates that there has been a marked improvement in the flow of many of the wells since the stoppage of pumping operations by private owners.

Of timely interest, in view of the proceedings looking toward the conservation of the mineral waters at Saratoga, is the report by James F. Kemp which appeared during 1912 as Bulletin 159 of the New York State Museum. After an introductory sketch of the historical features connected with the springs, the report describes the local geology in its bearing upon the methods of accumulation and storage of the waters, regarding which various views have been presented by geologists and chemists. There are chapters also on the composition of the springs, the carbon dioxid that accompanies their issue, temperature, gravity, classification, and variations that have been noted in the character of certain springs with the lapse of time. In the discussion of origin, Professor Kemp brings out the various data that appear to be related to the problem, upon which he bases the conclusion that the waters are essentially deep-seated, though taking their content of calcium and magnesian carbonates from the limestones near the surface and mingling with meteoric waters in their ascent. Numerous chemical analyses of the waters are appended to the text.

NATURAL GAS

The natural gas industry of New York has shown surprising vigor during the last few years. The State ranks as one of the first in which this valuable fuel was produced, but the resources have apparently not yet been developed to their maximum capacity, except perhaps in the oil well region which has been more thoroughly prospected than any other section. The gas fields, as distinct from those of oil and gas in the southern parts of Allegany and Cattaraugus counties, are mostly small as to area and by no

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means comparable in their yield to some of the natural gas fields of Pennsylvania and Ohio, but they bear evidence of great persistence when once tapped, which is a very important feature.

The production of the State is contributed by sixteen counties altogether, including Allegany, Cattaraugus, Chautauqua, Erie, Genesee, Livingston, Monroe, Niagara, Onondaga, Ontario, Oswego, Schuyler, Seneca, Steuben, Wyoming and Yates. These comprise the section west of the meridian of 77°, with an outlying area on the north and east near the eastern end of Lake Ontario. The existence of natural gas has been demonstrated for a number of other counties, as far north as Jefferson and as far east as Albany, but in too small quantity to have economic importance.

The supply of natural gas is derived from several geologic horizons, from the Potsdam sandstone in the Cambric to the Chemung strata at the top of the Devonic. The more productive formations include the Trenton limestone of the Lower Siluric, the Medina sandstone of the Upper Siluric, and the Portage and Chemung shales with interbedded sandstones belonging to the Devonic. With few exceptions the gas pools now producing occur in one or another of these formations.

The oil fields of Allegany and Cattaraugus counties have contributed, and still do contribute, considerable quantities of gas. The pools are found in sandstones at different horizons in the Devonic, such as the Bradford, Kane, and Elk "sands" of the Chemung. Some of the supply is consumed in the gas engines for pumping the oil, and the remainder is used for lighting and heating in the local towns or is piped to Buffalo. The distribution of the gas is mainly in the control of a few companies, like the Empire Gas & Fuel Co., of Wellsville, the Producers Gas Co., of Olean, and the United Natural Gas Co., of Oil City, Pa. Some of the local towns supplied from the fields are Olean, Andover, Wellsville, Friendship, Hornell and Geneseo. In the northwestern part of Cattaraugus county there is a small field of which Gowanda is the center and which extends across the border into Erie county. The gas is said to occur in the Marcellus and Onondaga formations of the Middle Devonic. The output is distributed by the Gowanda Gas Co. for use in Gowanda. Explorations have been under way recently in northern Cattaraugus county between Gowanda and Cattaraugus where pools are reported at depths from 2500 to 3300 feet in what is supposed to be the Medina sandstone.

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In Chautauqua county, the productive area comprises a belt bordering Lake Erie from Silver Creek southwest to the Pennsylvania state line. Until quite recently, the supply has been obtained from wells a few hundred feet deep in the Portage and Chemung beds and the individual output was small, sufficing for a few families at most. Deep drilling during the past few years has resulted in the discovery of more productive pools, lying at depths from 1900 to 2300 feet in what is considered Medina sandstone. Some very large flows have been encountered in the vicinity of Silver Creek, Dunkirk, Forestville, Sheridan and Westfield. These wells are mainly owned by local companies who sell the output in the neighboring towns and villages. The principal operators include the Frost Gas Co., Silver Creek Gas and Improvement Co., South Shore Gas Co., and Welch Gas Co. During the past year, the United Natural Gas Co. has been engaged in exploration in the town of Arkwright east of Fredonia and is reported to have encountered gas in quantity at depths around 2100 feet.

Erie county contains several fields. A few wells have been put down within the limits of Buffalo. East Aurora, Collins, North Collins, Angola and Springville in the southern part are centers of a more or less active industry. Within the last fifteen years a field has been opened east of Buffalo in the towns of Cheektowaga, Amherst, Lancaster, Clarence, Alden and Newstead, which for some time has been the most productive in the State. The gas is found in the Medina sandstone at depths of from 1200 to 1600 feet, and the wells have proved quite persistent producers. It is transported in pipe lines to Buffalo, Tonawanda, Batavia, Lancaster, Depew, Honeoye Falls, and other towns in the vicinity. There are over 200 productive wells in the field.

In Genesee county a prolific field has been developed at Pavilion during the last five years. The gas is found in the same horizon as in Erie county, at depths of about 1700 feet. The Pavilion Natural Gas Co. and the Alden-Batavia Natural Gas Co. are the chief operators in the field and supply the gas to Pavilion, Leroy and Batavia.

In Wyoming county a few wells are in operation at Attica; in Livingston county at Caledonia, Avon and Lima; and in Ontario county in the towns of East Bloomfield and West Bloomfield. Further east in Onondaga county there are wells at Baldwinsville and Phoenix which supply gas for local use. The pools are found in the Trenton shales and limestone. Oswego county marks the

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eastern limit of the productive territory, with wells at Pulaski and Sandy Creek.

Production. The value of the natural gas production for the last four years is shown in the accompanying table which attempts also to divide it among the leading districts. The securing of figures from each county or district separately has become a matter of considerable difficulty in the last year or so, owing to the consolidations among the distributing companies who, operating in many fields, do not keep separate records.

The production for the year 1912 had a value of $1,882,297 and was much the largest that has been reported. The gain over the yield for 1911 was more than 20 per cent. That the increase really reflected a growth of the industry, not a mere rise of prices, is demonstrated by the returns of the companies in regard to the well flow which amounted to 6,564,659,000 cubic feet as compared with 5,127,571,000 cubic feet in 1911, 4,815,643,000 cubic feet in 1910 and 3,825,215,000 cubic feet in 1909. These amounts include estimates for some of the smaller producers who have no meters attached to their mains, but they are close approximations to the actual yield.

The average price received for the gas sold for general consumption was 28.7 cents a thousand in 1912, against 30 cents in the preceding year. This indicates a slight decrease in price, but may be accounted for largely by the larger gain of output in the western fields where the gas brings a relatively low price and little or no gain in the outlying districts that are favored by higher prices.

Production of natural gas

COUNTY	1909	1910	1911	1912
Allegany-Cattaraugus	$282 964	$337 427	$402 931	$1 503 274
Chautauqua	174 597	202 754	222 023	263 742
Erie [1]	461 531	717 038	813 279	[4]
Livingston [2]	59 888	60 907	73 357	81 740
Onondaga	12 310	12 733	12 972	14 260
Oswego	14 402	14 783	14 913	16 366
Wyoming [3]	40 001	65 967	7 602	2 915
Total	$1 045 693	$1 411 699	$1 547 077	$1 882 297

[1] Includes output of Genesee county for 1911 and part of it for the preceding years.
[2] Includes also Seneca, Schuyler, Steuben, Ontario and Yates.
[3] Includes Niagara and also some of Genesee except for 1909 and 1910.
[4] The production of Erie and Genesee counties in 1912 is included under Allegany-Cattaraugus.

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The reports for the year 1912 covered a total of 1660 wells, besides the oil wells of Allegany and Cattaraugus counties that produce gas as a by-product.

Erie county has the largest output of any county in the State, but owing to the conditions obtaining there in the commercial distribution of the gas, its product for 1912 can not be definitely stated. Its output, with that of Genesee county, is included under Allegany-Cattaraugus counties. These four counties together contributed a total of 5,294,478,000 cubic feet with a value of $1,503,274. The district east of Buffalo continued to be the main producer in Erie county, but the most important developments of the year took place in the vicinity of Orchard Park, town of East Hamburg, south of that city. The Orchard Park Gas Co. drilled the first well in April, which was followed rapidly by others put down by the same company and by the Buffalo Natural Gas Co. Altogether 20 wells have been drilled, indicating a rather small but quite productive pool in that vicinity. The Iroquois Gas Co. of Buffalo took over, during the year, the interests and franchises of the United Natural Gas Co., one of the larger operators in the western fields, and also those of several of the smaller companies in Erie county.

In Chautauqua county, the lake shore district maintained its activity and yield. New wells were drilled by the Frost Gas Co., near Silver Creek; by the United Natural Gas Co. and its successors, the Iroquois Gas Co., in Arkwright township, and by other companies.

Good wells are reported to have been brought in at Red House, Cattaraugus county, the yield having been around 1,000,000 cubic feet a day.

PETROLEUM

The year 1912 witnessed exceptional conditions in the petroleum fields of the State. In the face of steadily advancing prices, production fell to the lowest stage reached since systematic developments were started in the Allegany county district about thirty-five years ago. Considered by itself, this seemingly discouraging situation might lead to the impression that the oil industry had nearly reached the end, so far as the local crude supplies are concerned; or at least that the latter were no longer capable of a sustained output. A study of the statistics of prices and production for the few preceding years, however, indicates that the decline

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may be explained rather by economic considerations than by the failure of the natural resources.

As a matter of fact, the oil pools long since reached their maximum capacity for production, but by continued redrilling of the proved territory the yield for the last two decades has been fairly well maintained. The oils are mostly of superior quality with a paraffin base, characteristic of the Appalachian fields, and bring the highest prices in the market, so that under normal conditions the industry is remunerative, even though the yield for each well is very small.

The average output until recently has remained nearly constant at a little over a million barrels a year. Fluctuations have depended mostly upon the state of the market. A severe slump in the latter took place in 1910, the prices declining steadily from month to month until the reduction amounted to over 50 cents a barrel. This practically put an end to development work, and pumping operations at many of the less productive wells were stopped. The effects of this depression were noticeable to some extent in the returns made for the year 1911, but the full force of it became manifest in last year's total.

With the falling off in yield which affected the Appalachian districts generally, prices began to strengthen and from the low point of $1.35 a barrel in January advanced steadily throughout the remainder of the year, reaching the price of $2 a barrel at the close. This was higher than New York crude sold for previous to the decline of 1910, so that development work should once more resume its normal course. An improvement in the productive industry may be anticipated for the current year, unless conditions show a sudden reversal.

The output of oil in the State during the last two decades is given in the accompanying table. The figures for the years 1893–1903 have been taken from the annual volumes of "The Mineral Resources" and those for the following years compiled from reports rendered by the pipe-line companies and shippers who operate in the State. The list of these companies is as follows: the Allegany Pipe Line Co., Columbia Pipe Line Co., Union Pipe Line Co., and Fords Brook Pipe Line Co., of Wellsville; Vacuum Oil Co., of Rochester; New York Transit Co., of Olean; Emery Pipe Line Co., Kendall Refining Co., and Tide Water Pipe Co., Limited, of Bradford, Pa.

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Production of petroleum in New York

YEAR	BARRELS	VALUE
1893	1 031 391	$660 000
1894	942 431	790 464
1895	912 948	1 240 468
1896	1 205 220	1 420 653
1897	1 279 155	1 005 736
1898	1 205 250	1 098 284
1899	1 320 909	1 708 926
1900	1 300 925	1 759 501
1901	1 206 618	1 460 008
1902	1 119 730	1 530 852
1903	1 162 978	1 849 135
1904	1 036 179	1 709 770
1905	949 511	1 566 931
1906	1 043 088	1 721 095
1907	1 052 324	1 736 335
1908	1 160 128	2 071 533
1909	1 160 402	1 914 663
1910	1 073 650	1 458 194
1911	955 314	1 251 461
1912	782 661	1 338 350

The total production in 1912 amounted to 782,661 barrels, as compared with 955,314 barrels in 1911. The decrease was 172,653 barrels, or about 20 per cent. The output in 1910, which was 1,073,650 barrels, showed a drop of 158,336 barrels or about 15 per cent from that of 1909 when the first break in the market prices began. The value of the output last year was $1,338,350, an average of $1.71 a barrel, against $1,251,461 or an average of $1.31 a barrel in 1911 and $1,458,194 and an average of $1.36 in 1910 and $1,914,663, an average of $1.65 in 1909.

The record of field work as compiled monthly by the Oil City Derrick showed that 246 wells were drilled in the New York fields during 1912. This figure indicates a slightly increased activity over the preceding year, when the number completed was 195. The number of wells completed in 1910 was 283 and in 1909, when conditions were more normal, the number was 457. The increment of production from the new wells amounted to only 278 barrels, as compared with 201 barrels in 1911, 368 barrels in 1910 and 715 barrels in 1909. Of the number of wells completed, 66 were dry against 59, 61 and 32 respectively in the preceding years.

The oil pools found in the State constitute the northern extension of the Appalachian field which reaches its main development in

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Pennsylvania, Ohio and West Virginia. They underlie small areas in Cattaraugus, Allegany and Steuben counties near the Pennsylvania border. The first well was drilled in Cattaraugus county in 1865, and Allegany county began producing about 1880. The oil is found in fine-grained sandstones of dark color belonging to the Chemung formation of the upper Devonic. In Cattaraugus county the productive area embraces about 40 square miles, mostly in Olean, Allegany and Carrolton townships. The pools of which the principal ones are the Ricebrook, Chipmunk, Allegany and Flatstone, occur at several horizons from 600 to 1800 feet below the surface. The oil district of Allegany county extends across the southern townships of Clarksville, Seneca, Wirt, Bolivar, Alma, Scio and Andover and is divided into several pools that are considered to be more or less independent. The Bolivar, Richburg and Wirt pools have been most productive. The oil is found at depths of from 1400 to 1800 feet. The Andover pool lies partly in the town of West Union, Steuben county, and is accountable for the production in that section. The reports of the "Mineral Resources" covering the year 1910 showed a total of 10,995 productive wells in the State, of which number Allegany county had 7859, Cattaraugus county 2917 and Steuben county 219. Practically all the wells are pumped and the average yield is less than one-third of a barrel a day.

There has been a great deal of exploration outside the districts mentioned, but up to the present time has not led to any positive additions to the productive area. Some of the more interesting and promising developments have been in northern Allegany county. A discovery of oil was reported a few years since in the town of Granger on the Livingston county border, considerably north of the other pools, and about 30 wells were drilled as a test. Some of these flowed under natural pressure, but they soon gave out, yielding less than 3000 barrels altogether. In the last year or two another section near Swain, town of Grove, has been under exploration. The original discovery was reported on the Fred Bennett farm where oil and gas were encountered in a well put down to 740 feet depth. Some other holes in the same vicinity were dry. Recently drilling has been under way on the Harman place, and two productive wells are reported to have been brought in of which the first produced from 5 to 6 barrels a day. The second was dry when drilled, but began to flow after having been "shot." The oil is said to be of a dark, heavy quality.

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PYRITE

The pyrite deposits of St Lawrence county contributed an increased output of that mineral last year, though no new properties were under operation. The main factor in the industry was the St Lawrence Pyrite Co. at Stellaville where it owns extensive mining properties inclusive of the Stella, and a large mill for concentrating the ore. The company only recently attained its present stage of productive activity which places it among the more important producers and shippers of pyrite in the country. The output is mainly in the form of concentrates with a content of 40 per cent or more in sulphur, but a small proportion is shipped as cobbed ore or spalls, with a somewhat smaller tenor of sulphur. The pyrite is used by acid burners in the eastern states, and is considered a very desirable material for their purposes on account of its relative freedom from arsenic and other injurious impurities.

The Hinckley Fibre Co. continued work at the Cole mine near Gouverneur, making shipments of the crude pyrite to its sulphite pulp mills in the Adirondacks. The company has developed a process by which the low-grade material as it comes from the mine can be utilized successfully for making sulphurous anhydride and calcium sulphite, of which very large quantities are employed in the local pulp mills. It would appear that an extensive market for the St Lawrence county pyrite might be developed if the crude ore were generally applicable to sulphite manufacture.

An occurrence of pyrite in the town of Fowler, southeast of Gouverneur, received some attention during the year, and shipments of a few tons of the ore were made for experimental purposes. The locality from which the ore was taken is on the Kilburn place, near Little York. A band of quartz-amphibolite schist, apparently a part of the sedimentary or Grenville series, can be followed in outcrop for a mile or more, its surface being deeply stained by iron oxids. Pyrite occurs more or less abundantly scattered all through the schist and in places forms richer veinlike bands or irregular aggregates which are also distinguished by the coarse character of the mineral. Shallow pits have been sunk at one or two points from which the ore for experiment was taken. The deposits, like many of the other Adirondack occurrences, contain pyrrhotite along with the pyrite, but the former mineral is most in evidence in the southern part of the ore zone.

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SALT

The production of salt is one of the larger and more stable branches of the mineral industry and has been carried on in New York State for upwards of a century. The occurrence of rock salt is widespread in the central and western counties, south of the Salina outcrop, but its exploration through mine shafts or wells is restricted to a few places that possess natural advantages for conducting these operations and for marketing the product. At present, 6 counties contribute to the output, with a total of about 30 individual mines and evaporating works.

Few changes in the industry have taken place recently and it is hardly to be expected that any notable developments will occur in the near future. The productive capacity of the local plants long since reached or passed the point of equilibrium with the market requirements. This condition has caused keen competition and brought about the extinction of some of the smaller and less favorably situated enterprises. The industry as a whole, however, seems to be on a firm basis and except for some uncertainty as to the results of the new tariff which proposes to remove the duty on foreign salt, the outlook for the immediate future is more encouraging than it has been in several years.

Reports from all the companies operating last year showed a production of 10,502,214 barrels of 280 pounds. This was the largest total that has ever been returned for a single year, the next largest having been in 1910 when it amounted to 10,270,273. Compared with the output of 10,082,656 barrels in 1911 there was a gain of 419,558 barrels or about 4 per cent. Converted to a tonnage basis, the product last year was equivalent to 1,470,309 short tons, against 1,411,572 short tons for 1910.

The value of the salt production as fixed by the figures reported by the companies was $2,597,260, exclusive of the cost of package and freight to market. From this, an average of 24.7 cents a barrel is obtained for the whole amount. The prices received for evaporated salt were generally higher than in the preceding year and in fact in any other year since 1907. Under the highly competitive conditions that have existed in the local markets as well as in those of other states where the New York producers have a foothold, prices had slumped steadily during the previous few years. In 1911, the average value was only 21.7 cents, whereas it was 22 cents in 1910, 23.3 cents in 1909, 23.7 cents in 1908 and 25 cents in 1907.

It is to be noted that the average values as given are for the

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entire amount of salt taken from the mines and wells, and that a certain and not inconsiderable part of this amount represents the salt contents of brine which is not evaporated, but converted directly into alkali products. On this part of the output a very low valuation, representing practically the mere cost of pumping, is placed. The production of this brine is confined to a single company, the Solvay Process Co., which has a number of wells in the town of Tully, Onondaga county, whence the brine is carried by pipe line to the alkali works near Syracuse.

The accompanying tables give the statistics of the salt production for recent years. For the years 1911 and 1912 the output is given according to grades, so far as the classification could be made without revealing the individual figures. The grades depend upon methods of manufacture and purposes for which the salt is used. Rock salt and salt in brine consumed by the alkali industry appear in the last item of the detailed tables which also includes small quantities of evaporated salt not specially classified in the returns. The evaporated salt is chiefly marketed under the grades of common fine, table and dairy, common coarse, common solar, and packers salt. Table and dairy salt includes the finest grades of artificially evaporated salt specially prepared for the table and for butter and cheese making; it brings the highest market price. Under common fine are listed the other grades of fine, artificially evaporated salt that are not specially prepared. Common coarse represents the coarser product from artificial evaporation. Coarse solar salt is made by evaporation of brine in shallow pans exposed to the sun's heat. This process is employed only by the manufacturers in Syracuse and vicinity, and can be carried on, of course, only in the summer months. Packers salt includes the product sold to meat packers and fish salters.

Production of salt by grades in 1911

GRADE	BARRELS	VALUE	VALUE A BARREL
Common fine [1]	1 143 886	$328 127	$.29
Common coarse	285 407	96 968	.34
Table and dairy	1 312 000	629 581	.48
Coarse solar	434 414	131 247	.30
Packers	40 721	11 402	.28
Other grades [2]	6 866 228	994 160	.14
Total	10 082 656	$2 191 485	$.217

[1] Common fine includes a small quantity of common coarse.
[2] Include rock salt, salt in brine used for soda manufacture, and small amounts of brine salt for which the uses were not specified in the returns.

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Production of salt by grades in 1912

GRADE	BARRELS	VALUE	VALUE A BARREL
Common fine [1]	1 408 543	$519 844	$0.37
Common coarse	204 136	82 880	.41
Table and dairy	1 353 643	819 103	.61
Coarse solar	296 814	103 886	.35
Packers	72 771	30 564	.42
Other grades [2]	7 166 307	1 040 983	.15
Total	10 502 214	$2 597 260	$.247

[1] Common fine includes a small quantity of common coarse.
[2] Include rock salt, salt in brine used for soda manufacture, and small amounts of brine salt for which the uses were not specified in the returns.

The output in 1912 was contributed by 30 mines and works distributed among 6 counties of the State. Onondaga county was represented by the largest number of producers, having 20 in all. Livingston county was represented by 3, of which 2 were rock salt mines, the only ones now active. Schuyler, Tompkins and Wyoming counties each had 2 producers, and Genesee county had 1.

Production of salt in New York since 1887

YEAR	BARRELS	VALUE
1887	2 353 560	$936 894
1888	2 318 483	1 130 409
1889	2 273 007	1 136 503
1890	2 532 036	1 266 018
1891	2 839 544	1 340 036
1892	3 472 073	1 662 816
1893	5 662 074	1 870 084
1894	6 270 588	1 999 146
1895	6 832 331	1 943 398
1896	6 069 040	1 896 681
1897	6 805 854	1 948 759
1898	6 791 798	2 369 323
1899	7 489 105	2 540 426
1900	7 897 071	2 171 418
1901	7 286 320	2 089 834
1902	8 523 389	1 938 539
1903	8 170 648	2 007 807
1904	8 724 768	2 102 748
1905	8 575 649	2 303 067
1906	9 013 993	2 131 650
1907	9 657 543	2 449 178
1908	9 005 311	2 136 736
1909	9 880 618	2 298 652
1910	10 270 273	2 258 292
1911	10 082 656	2 191 485
1912	10 502 214	2 597 260

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The large number of producers in Onondaga county is incident to the solar salt industry which is carried on extensively around Syracuse. The brine used by the solar evaporating works or salt yards is stored in glacial gravels and is pumped and distributed by central plants. The principal supply comes from the old Onondaga Salt Springs Reservation that was sold by the Indians to the State in 1788. The manufacture of salt was placed under State control in 1797 from which time complete records of the industry are available. At one time artificial evaporation was extensively practised but this has been given up almost entirely in recent years with the increased competition from other districts. The solar salt is sold through the agency of the Onondaga Coarse Salt Association.

With the exception of the salt made at Syracuse, the entire production is obtained from the deposits of rock salt which are found in the Salina formation, a succession of shales and limestones with intercalated beds of gypsum and rock salt. The Salina strata outcrop in an east-west belt across the State from Albany county to the Niagara river and is represented by a smaller separate area in southeastern New York. Well tests indicate that the salt deposits are restricted to the western section of the main belt beginning in Madison county; east of there the strata diminish in thickness to such an extent as to preclude their existence. They are encountered only at a depth of 1000 feet or more where there has been sufficient cover to protect them against solution by ground waters. As the whole stratified series has a dip uniformly toward the south, the mines and wells are all located on the southern side of the outcrop which lies about on the line of the 43d parallel. The dip averages 40 or 50 feet to the mile. The most easterly point where rock salt has been found is at Morrisville, Madison county. Between that place and Lake Erie it has been shown to exist in almost all counties of the middle tier.

The exploration of the rock salt beds dates from 1878 when a well bored for oil near Wyoming, Wyoming county, encountered 70 feet of salt at 1270 feet from the surface. Discoveries were subsequently made at Warsaw, Leroy, Rock Glen, Batavia and numerous places in Livingston, Wyoming and Genesee counties. Practically the whole valley of Oatka creek, from Leroy to Bliss and the Genesee valley south of Monroe county has been found to be salt-bearing. The region is now the most productive in the State. Livingston county has the largest annual output which is contributed by the two rock salt mines at Retsof and Cuylerville

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owned respectively by the Retsof Mining Co. and the Sterling Salt Co., and by the evaporating plant of the Genesee Salt Co., at Piffard. The other companies now active in this section include the Leroy Salt Co., of Leroy; the Rock Glen Salt Co., of Rock Glen; and the Worcester Salt Co., of Silver Springs.

In Schuyler county salt is obtained around Watkins. The Glen Salt Co. sank the first well there in 1893 and encountered a deposit at 1846 feet depth. The plant is now operated by the International Salt Co. The Watkins Salt Co. also has works at this place.

A well drilled at Ithaca, Tompkins county, in 1885 passed through seven beds of salt aggregating 248 feet in thickness at depths below 2244 feet from the surface. The discovery was followed by active developments at Ludlowville in 1891 by the Cayuga Lake Salt Co., and at Ithaca in 1895 by the Ithaca Salt Co. The plants were taken over in 1899 by the National Salt Co., which was merged in 1905 into the International Salt Co. The Remington Salt Co. later erected a plant at Ithaca which is now in operation obtaining its salt from three wells at a depth of about 2100 feet.

The Solvay Process Co. derives its supply of brine from a number of wells located in the town of Tully, 20 miles south of Syracuse. The brine is carried in pipe line to the works at Solvay.

In Erie county rock salt has been found at Eden Valley, Springville, Perry and Gowanda, but there is no output at present in that county. Among the localities where discoveries have been made may be mentioned Vincent and Naples, Ontario county; Dundee, Yates county; Seneca Falls, Seneca county; and Aurora, Cayuga county. None of these deposits are worked. A well put down in 1909 in the town of Burns, Allegany county, is reported to have passed through 75 feet of clean unbroken salt at 3050 feet depth.

SAND AND GRAVEL

The production of sand and gravel for use in engineering and building operations, metallurgy, glass manufacture, etc., is an important industry involving a very large number of individual operations. The building stone business is specially extensive as there are deposits suitable for that purpose in every section of the State, and nearly every town or community has its local source of supply. Such sand, of course, possesses little intrinsic value. The deposits of glass sands and molding sands are more restricted in their distribution and their exploitation is the basis of a fairly stable industry; certain molding sands are even shipped to distant points, as in the case of those obtained in the Hudson River region.

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The sand and gravel beds of the State are mainly of glacial origin, as the whole territory within the limits of New York, in common with the northern section of the United States east of the Rocky mountains, was invaded by the Pleistocene ice sheet which removed all the loose material accumulated by previous weathering and erosion, and left in its retreat a mantle of transported boulders, gravels, sands and clays. In places these accumulations have the character of unmodified drift or morainal accumulations in which the materials are more or less intermixed, and are then of little industrial value. But more generally the deposits show a sorted stratiform arrangement due to having been worked over by the glacial streams and lakes. Such is the condition in many of the larger valleys like those of the Hudson, Champlain and Genesee where sands, gravels and clays occur separately in terraced beds extending far above the present water level. Later water action may have effected a beneficial re-sorting of the materials as instanced by the beach sands of Long Island and some of the lakes in the interior of the State.

A measure of the importance of the sand and gravel industry may be had from the accompanying table which, however, lacks something in the way of completeness and accuracy. The figures relating to the molding sand production are believed to be a close approximation to the actual totals, but those for building sand and gravel may vary considerably from the true quantities, perhaps understating them by as much as 25 per cent. The building sand operations are so widely scattered and in many sections carried on in such haphazard or fugitive manner that it is extremely difficult to cover them all in a statistical canvass.

Production of sand and gravel

MATERIAL	1910	1911	1912
Molding sand	$424 015	$420 780	$422 148
Core and fire sand	33 709	27 484	55 910
Building sand	1 016 598	*b* 750 000	1 156 002
Other sand *a*	65 835	*b* 50 000	*b* 75 000
Gravel	589 551	479 103	840 669
Total	$2 129 708	$1 727 367	$2 549 729

a Includes glass sand, filter sand, engine and polishing sand.
b Partly estimated.

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Molding sand. The business connected with the locating, digging, grading and shipment to market of molding sands involves a degree of skill and experience on the part of the operator that makes it a rather specialized branch of the industry. Sands possessing the requisite qualities for employment in the molding of metals are also rather restricted in distribution. The business, therefore, has elements of stability and permanency not shared to any extent by most of the other branches.

The main output of molding sands in New York comes from the middle Hudson valley. The deposits that are actively worked extend along both sides of the river from Washington and Saratoga counties on the north to Orange and Dutchess counties on the south. The product is often spoken of as "Albany" molding sand, probably owing to the fact that Albany is near the center of the district. Albany county furnishes a large part of the output, most of which is dug in the southern townships of Bethlehem and Coeymans.

Throughout the region there is much similarity in the occurrence of the sand. It is always found directly below the soil, and where this is lacking, as in the sand dune tracts of Albany and Schenectady counties, the sand is also absent. The thickness of the soil cover, which has the character usually of a sandy loam, well sodded, averages about one foot. There is no sharp division between soil and molding sand, the change being manifested by a gradual decrease of plant fibers and carbonaceous matter as the valuable layer is reached. The underlying material consists of sand that is sometimes difficult to differentiate from the molding sand itself. As a matter of fact, there are no fixed standards determining the selection, and there is considerable variation in the physical qualities of the sands shipped by the different producers. The most valuable grades consist of the very fine sands which can be used for brass and stove castings; they are consequently most sought for and may be exploited exclusively even when accompanied by coarser kinds that have a more limited sale.

The most notable feature of the distribution geologically is that the sands occupy the site of the glacial Lake Albany. This lake, formed in late Pleistocene time, reached well up the slopes of the middle Hudson valley and the confluent branches and was fed by the flood waters resulting from the melting of the ice sheet in its northward retreat. These waters washed down the rock-waste of clays, sands and gravels made by the erosion of the ice and brought

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them into the lake when they were laid down in more or less sorted and stratified deposits. The deltas of the Mohawk and other large tributary streams of that period furnish the principal supplies of the molding sand.

The typical product of this region, that is the finer grades, is characterized by a degree of comminution and angularity of the particles unusual to water-worn sands. It is probable that these features are the result of ice erosion in the first place, but they may have been further developed by wind action after the retreat of the waters and before the deposits became fixed in place by vegetation. At least there are indications in places that the winds effected the final sorting and have deposited the sands in their present attitude which is quite different from that resulting from water work.

The molding sand does not mark the outcrop of any definite layer or layers within the series of interstratified clays and sands, but forms a mantle that follows the surface configuration. It rises and falls with the minor irregularities of the surface, showing a variation of elevation inconsistent with the regular order that would be expected from a water-laid deposit. The thickness of the molding sand is also quite variable, running from a few inches in some places to several feet in other localities. These features have recently been remarked by Stoller,[1] who bases on them a theory as to the secondary origin of the molding sand through the operation of surface agencies, specially oxidation and moisture. "It appears to be a necessary inference from this that surface conditions are a determining cause in the origin of the layer of molding sands. In dry seasons of the year when the surface soil has been largely deprived of water by evaporation, an upward movement of the ground water by capillarity takes place. If the ascending ground water carries iron in solution, the iron may be oxidized and precipitated as it approaches the surface. In this way, the film of iron oxid coating the particles of sand is formed. The porosity of sand, admitting air to a considerable depth below the surface and at the same time favoring evaporation, facilitates the process. In addition to the iron, it is probable that small particles of clay are carried upward by the moving ground waters and are fixed through cementation by the iron oxid. These processes continue from season to season through a long period of years, the layers of molding sand being periodically added to at the bottom until it

[1] Glacial Geology of the Schenectady Quadrangle. N. Y. State Mus. Bul. 154, p. 24 and 25.

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attains such a thickness that surface influences no longer penetrate it."

That the weathering action incident to exposure of the sand to oxidation, hydration and physical agencies does work a beneficial change upon the molding sand admits of little doubt, though there is much uncertainty as to just what the process and its importance may be. It is, however, not simply a product of weathering upon the ordinary water-laid sands of this section, but the salient features of its occurrence and origin, at least in some places, are to be ascribed probably to the action of wind. The somewhat patchy distribution; the occurrence without relation to any horizon, but following the surface contours at least in minor undulations; the variable thickness; and the marked angularity of the quartz particles are suggestive of wind agency in the final accumulation of the deposits.

The main part of the product of the region, as stated, consists of the finer sizes. The companies who operate on a permanent basis and in various sections usually are able to supply the various grades for which a market demand exists. The grades are not standardized and their designation by different shippers lacks uniformity. Some five or six are shipped at present. They bear numbers, beginning with zero which represents fine brass sand and running up to no. 4 which is rather coarse. Perhaps the grade most shipped is no. 1 or stove-plate sand. A screen test on a representative sample of this grade from Selkirk gave the following results: through 100 mesh, 96.64 per cent; on 100 mesh, 2.62 per cent; on 80 mesh, .39 per cent; on 60 mesh, .04 per cent; on 40 mesh, .07 per cent; on 20 mesh, .21 per cent.

Aside from the Hudson River region, there is some molding sand obtained in the western part of the State, mainly in Erie and Chautauqua counties. The output there amounts to a few thousand tons a year.

For the year 1912, the returns received indicate a total production for the whole State of 469,138 short tons with a value of $422,148. The total has not varied much in recent years, having been 476,014 tons valued at $420,780 in 1911 and 471,351 tons valued at $424,015 in 1910.

Core sand used in connection with molding sand for the cores of castings is chiefly produced in Erie and Oneida counties. The product is listed with fire sand, the combined production of the two kinds last year amounting to 87,525 short tons valued at $55,910.

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Glass sand. Sand for glass manufacture is obtained from the beach sands of Oneida lake and Long Island. The crude sand undergoes purification by washing to remove the clay, mica, iron oxid, organic matter, etc. The manufacture of window glass, once an important industry in the central part of the State in the vicinity of Oneida lake where the sand was obtained, is no longer carried on, as competition with the industry in regions more favored by fuel supplies rendered it unprofitable. The small product of a few thousand tons is shipped elsewhere for manufacture.

Building sand. The use of sand and gravel in building and engineering work calls for enormous quantities of these materials. The business of excavating and transporting them to market is a purely local one, except in certain parts of Long Island from which the supply for New York and its environs is mostly obtained.

A complete census of the sand industry can be obtained only with an outlay of labor and expense which the results would hardly justify. The figures given herewith are simply an approximation based on reports received from producers operating in the principal localities which sustain a more or less steady output. They no doubt understate the total, as there are a large number of small producers who do not report.

The combined value of the sand and gravel as returned for the year 1912 was $1,996,671. The total for the preceding year was $1,229,103. Of the amounts named, $1,156,002 represents the value of the sand and $840,669 that of gravel. Nassau county alone had an output of 2,411,866 cubic yards of sand and 546,687 cubic yards of gravel with a combined value of $1,539,621.

SAND-LIME BRICK

The sand-lime brick manufacturers experienced a very successful season in 1912, as evidenced by their large output. They were favored by an active demand for structural materials that obtained throughout most sections of the State, and it would appear also that the material has been gaining in popularity since its rather recent appearance on the market. There were fewer plants operated than in earlier years, but the average production was considerably larger.

The number of brick made within the year was 21,231,000, as compared with 15,178,000 in 1911. The total has never been exceeded; the largest output previously was in 1906 when it numbered 17,080,000. The value of the product for the last season was

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$133,736, or an average of $6.30 a thousand. In the preceding year the value of the outturn was $92,064, an average of approximately $6 a thousand.

The active manufactures included the following: Buffalo Sandstone Brick Co., with a plant at Lancaster; Dyett Sand-Lime Brick Co., Port Jefferson; Glens Falls Granite Brick Co., Glens Falls; Paragon Plaster Co., Syracuse; and Rochester Composite Brick Co., with plant at Brighton. The Sandstone Brick Co.'s plant at Schenectady was inactive, but will probably resume operations during the current season.

STONE

The quarrying of stone and its preparation for the varied requirements of building, engineering construction, etc., holds a prominent place in the industrial activity of the State, and the value of the annual contribution ranks second only to that of clay among mineral materials. No other mineral industry includes so many individual enterprises or is so widely represented in the different sections. The resources are abundant and varied, comprehending all the principal varieties known to the trade. The greater number of quarries, however, are opened in the limestones and sandstones and supply material chiefly for engineering work, highway improvement and such purposes which do not entail any considerable amount of elaboration previous to shipment. In the development of the building, monumental and ornamental branches the local industry has not attained the relative importance that it deserves by reason of the natural wealth of materials adapted to those uses and the advantages for marketing; herein lies, it would appear, the principal field for future enterprise.

The statistics of production which have been collected from year to year show that the industry in general remains practically stationary; in fact lately it has taken a downward trend, falling below the average level of earlier years. This has been due in part to the recent business reaction that has affected practically all industries and in part undoubtedly to the gaining favor of cement and concrete for certain construction purposes. The latter has manifested itself particularly in the loss of trade among the bluestone quarries which supply flagstone to New York and other eastern cities. This branch of the industry has shown a marked decline in the last few years.

The total value of the stone quarried in 1912 was $5,718,994, as compared with a reported value of $5,560,355 in 1911. This indicated a gain of $158,639 or about 3 per cent for the year, against

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a decrease for the preceding year of $737,940 or 12 per cent. It should be noticed that the totals as given are not inclusive of slate, millstones or limestone used for cement manufacture, which are reported separately.

Of the different branches of the industry represented in the State, the granite trade showed a slight improvement, increasing from $148,633 in 1911 to $202,086 last year. The yield, however, was below the average of earlier years.

The limestone quarries contributed more than one-half of the total for the year, with a product valued at $3,510,495. The figures for 1911 were $3,174,161. The use of limestone for crushed stone accounts for its predominant importance, though it is also largely employed for lime making, furnace flux, and for building stone.

There was a slight falling off in the value of the marble quarried which amounted to $241,847, against $278,041 in the preceding year. The decrease was in the building stone supplied by the southeastern New York quarries.

The sandstone quarries contributed an output valued at $1,280,743 against $1,060,106 in 1911. The increase of about 20 per cent did not restore the industry to the high level reached a few years ago, but indicated a temporary check at least to the decline that has recently taken place, incident to the unsatisfactory conditions of the flagstone trade.

The trap quarries in the Palisades section reported an output scarcely more than one-half that of previous years, in actual figures, $483,863 as compared with $899,414 in 1911. The decrease has been due to the shutting down of some of the river quarries by their inclusion in the new Palisades Park.

Production of stone in 1910

VARIETY	BUILDING STONE	MONUMENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite	$40 911	$12 989	*a*	$91 988	$98 875	$244 763
Limestone	99 040	.....	$3 888	1 815 809	1 327 061	3 245 807
Marble	252 965	88 684	.....	.....	231	341 880
Sandstone	387 408	.....	480 132	225 408	358 848	1 451 796
Trap	.....	.....	.....	908 931	75	909 006
Total	$780 333	$101 673	$484 020	$3 042 136	$1 785 090	$6 193 252

a Included under "All other."

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Production of stone in 1911

VARIETY	BUILDING STONE	MONUMENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite	$30 684	$11 353	*a*	$72 401	$34 195	$148 633
Limestone	112 082	.....	$11 989	1 936 292	1 113 798	3 174 161
Marble	171 748	79 115	.....	.....	27 178	278 041
Sandstone	327 587	.....	526 074	23 883	182 562	1 060 106
Trap	.....	.....	.....	896 164	3 250	899 414
Total	$642 101	$90 468	$538 063	$2 928 740	$1 360 983	$5 560 355

a Included under "All other."

Production of stone in 1912

VARIETY	BUILDING STONE	MONUMENTAL	CURBING AND FLAGGING	CRUSHED STONE	ALL OTHER	TOTAL VALUE
Granite	$65 487	$19 130	*a*	$49 307	$68 172	$202 096
Limestone	108 581	.....	$5 481	2 176 368	1 220 015	3 510 445
Marble	155 411	84 511	.....	.....	1 925	241 847
Sandstone	363 055	.....	615 846	45 301	256 541	1 280 743
Trap	.....	.....	.....	483 863	.....	483 863
Total	$692 534	$103 641	$621 327	$2 754 839	$1 546 653	$5 718 994

a Included under "All other."

GRANITE

Granite, in the strict sense, includes the coarser-grained igneous rocks which have quartz, feldspar and mica as their chief constituents. They are characterized by a massive appearance incidental to an even distribution of the mineral ingredients, though by compression during or after the period of consolidation they may develop a parallel arrangement, in which case the term granite gneiss is best applied to them. The feldspar of typical granite is an alkali variety, either orthoclase or microline, but some lime-soda-feldspar like oligiclase is usually present as well. Hornblende and more rarely augite may accompany the mica or substitute for it. The texture is even granular or porphyritic.

The definition as given is rather narrow for commercial usage

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and quarrymen often designate as granite widely different rocks which may serve more or less similar purposes. Thus in the Adirondacks not only granite, but syenite, anorthosite and various gneisses have been quarried and sold as granite. The broader usage will be followed here, so as to include practically all the crystalline silicate rocks, with the exception of trap which, owing to its somewhat specialized industrial features, will be treated by itself.

Granites and their igneous associates have a wide distribution in the Adirondacks and are represented rather extensively in the Highlands and in Westchester county. Some account of their distribution and present development for commercial use will be found in the preceding issue of this report. It may be said that the quarry industry in most localities is in a backward condition, neither commensurate with the resources which are sufficiently varied to meet most requirements for structural and ornamental granite, nor with the large local markets which exceed those of any state in importance. As a consequence, most of the building, monumental and ornamental granite for current use comes from the larger and better equipped quarries in New England and the southern states.

The production of granite for the last three years is shown in the accompanying table. The figures are compiled from reports of quarries operated for commercial purposes, but do not include the output by contractors on road improvement work, as such production is difficult to tabulate. The output in 1912 had a value of $202,096, against $148,633 in the preceding year and $244,763 in 1910. The largest item in the total was represented by building stone with a value of $65,487, followed by crushed stone valued at $49,307, rubble and riprap valued at $27,861 and monumental stone valued at $19,130. The granite sold for various other purposes was valued at $40,311.

Production of granite

	1910	1911	1912
Building	$40 911	$30 684	$65 487
Monumental	12 989	11 353	19 130
Crushed stone	91 988	72 401	49 307
Rubble, riprap	20 272	28 162	27 861
Other kinds	78 603	6 033	40 311
	$244 763	$148 633	$202 096

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NOTES ON GRANITE QUARRYING IN NEW YORK

Peekskill. The Mohegan Granite Co., owning quarries east of Peekskill, supplied a large part of the architectural granite produced in the last year, shipping most of the output to New York for use in the Episcopal Cathedral. The company is enlarging its facilities for handling this material which has obtained much favor among architects and builders on account of its rare and attractive color. At present it has three derricks in the main quarry, which is an opening 300 feet long with a face from 40 to 50 feet high. Except for large inclusions of hornblende schist which occur here and there, the granite is free of knots and streaks. It has a slight tendency to sheeting and is intersected by two sets of vertical joints which occur at such intervals as to admit the extraction of blocks as large as can be handled. The company has recently erected a steel-frame cutting shed at the quarries, which will afford room for 40 or 50 cutters.

The yellow and brownish varieties which have been mainly quarried are developed in the upper surficial part of the granite boss, as a result of the seepage of iron oxid into the minute cracks and pore spaces of the stone. The iron is principally concentrated about the quartz grains. It seems to have been derived from alteration of the biotite in the overlying portion which has since been eroded away, as the quarried stone appears quite fresh when examined microscopically. The granite is rather porous, but in crushing strength compares favorably with other granites.

The normal or original color of the Peekskill granite is light gray, or pinkish gray, as seen in the quarries of Rudiger Bros. on Millstone hill, across the valley from the Mohegan Company's quarries and in a smaller quarry near Peekskill. The change from gray to brown takes place at a variable depth, usually 40 or 50 feet from the surface.

Kensico. Quarries have been opened in the last year at Kensico for the construction of the new reservoir which is to form a part of the Catskill water-supply system. The quarries are situated on the ridge that limits the reservoir on the east, about three-fourths of a mile from the dam location with which they are connected by a railway. The rock is Yonkers gneiss of medium grayish or brownish gray color and more massive texture than the usual average of the rock. The grain is medium or fine. Several acres have been cleared of overlying earth and soil, showing fairly uniform and

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fresh material at the surface. There are scattered inclusions of dark hornblende and biotite gneiss, probably the Fordham, but with this exception it is quite free of admixture and well adapted for building and general construction purposes. Its composition is that of a normal biotite granite. The gneissoid character is partly at least original, rather than assumed after the crystallization, and the texture is firmly knit like that of a massive rock. The effects of shearing and compression are observable, however, in restricted areas. The granite is quarried by drilling and blasting. The heavier blocks are used for cyclopean masonry, and the smaller material goes to the crushing plant, which is a large concrete and steel structure.

Mamaroneck. Quarry operations are conducted by Faillace Brothers in an exposure of grano-diorite in the town of Mamaroneck, a little west of the village of that name. The rock belongs to the large intrusion which extends northeasterly across Rye and Harrison townships into Connecticut where it is known as the Danbury grano-diorite. It is medium to dark in color, with abundant biotite which by its linear arrangement lends a gneissoid appearance to the mass. It has a fine grain, varied at times by porphyritic feldspars which measure up to an inch in length. The porphyritic phase resembles very much the augen-gneiss at Bedford in northern Westchester county.

The Faillace quarry consists of an opening along a northeast-southwest ridge, 200 feet in length and 30 to 50 feet in height. The grano-diorite is here rather dark, rich in biotite, and carries considerable garnet. It shows traces of sheet structure as exposed in the quarry, the sheets being from 6 to 8 feet thick and dipping slightly southward. The principal set of joints strikes northeasterly parallel to the foliation and dips 75° or so northwest. Another system crosses this at a high angle but is irregular and at times obscure. The rock is quite uniform in appearance, being fairly free of knots and streaks and pegmatitic injections. The color effect of the cut stone varies somewhat on the different sides. Parallel to the foliation the biotite is more in evidence than the feldspar and lends a very dark, almost black, color to that side. Across the foliation, the color is grayish, mottled by the white feldspar augen, which are more prominent in the horizontal plane. For building purposes, it is cut so as to present the lighter color, across the foliation.

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In composition, the rock from this quarry is intermediate between granite and diorite. The feldspar in the ground mass is mainly plagioclase either oligoclase or andesine, while the porphyritic individuals which are clear and glassy have the characters of microcline. Quartz is fairly abundant and of smoky color. The reddish garnet occurs in scattered grains and large aggregates of grains, apparently a secondary development from the feldspar and biotite. A green hornblende occurs in small amount. The rock shows little weathering, except in the clouding of the plagioclase feldspar, and is a strong, tough building material.

The product of the quarries is mainly building stone which is cut and dressed by bush hammering at the quarries. The waste is used for riprap and crushed stone, a small crusher being set up on the property. Shipment is made by Mamaroneck station on the New Haven Railroad one-half mile distant from the quarries.

Campbell's quarry at Larchmont, which was described by Eckel in his paper "The Quarry Industry in Southeastern New York," has not been worked for a number of years and probably will not again be operated, as the vicinity is being rapidly developed for residence purposes. The grano-diorite is not so even in texture and rather more affected by weathering than at the other quarry localities.

A quarry has been opened along the ridge northeast of Campbell's quarry and one-quarter mile west of the New Haven Railroad. It has been idle during the last two or three years, but the waste is used in a crusher nearby. It has a face about 125 feet long on the strike of the grano-diorite gneiss and from 20 to 35 feet high. The rock contains more biotite and is therefore darker in color than that at the other quarries in this vicinity, while the foliation is more marked, resembling the structure of a typical gneiss. A few small bands and lenses of pegmatite afford the only noteworthy variation in the exposure. The strike of the foliation is northeast and the dip northwest at an angle of 75°. Two systems of nearly vertical joints run northeast and northwest respectively, besides which there is a fairly well-marked sheeting which dips 10° or so south. The joints divide the mass into cubical blocks that average 6 or 7 feet in each dimension. The product has been mainly used for building and other large structures. There is no equipment on the property at present.

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LIMESTONE

The stone classified under the heading of limestone consists for the most part of the common grades of limestone and dolomite such as are characterized by a compact granular or finely crystalline texture and are lacking in ornamental qualities.

A smaller part is represented by crystalline limestone and by the waste products of marble quarrying which is sometimes employed for crushed stone, lime making or flux. Limestone used for the manufacture of portland and natural cement is, however, excluded from the tabulations so as to avoid any duplications of the statistics.

Limestones have a wide distribution in the State, the only region which is not well supplied being the southern part where the prevailing formations are sandstones of Devonic age. The monocrystalline varieties occur in regular stratified order in the Cambric, Lower Siluric, Upper Siluric and Devonic systems. In most sections they occupy considerable belts and have been little disturbed from their original horizontal position. On the borders of the Adirondacks and in the metamorphosed Hudson River region, however, they have been more or less broken up by faulting and erosion and in places have a very patchy distribution.

The Cambric limestones are found in isolated areas on the east, south and west sides of the Adirondacks. They are usually impure, representing a transition phase between the Potsdam sandstones below and the high calcium limestones above. The lower beds of the Beekmantown formation as originally defined are now known to belong to the Cambric system. The Little Falls dolomite is perhaps the most prominent member of the Cambric limestones and is extensively developed in the Mohawk valley with quarries at Little Falls, Amsterdam, and other places. It is a rather heavily bedded stone of grayish color, suitable more especially for building purposes. In Saratoga county the Hoyt limestone is in part the equivalent of the Little Falls dolomite; it has been quarried for building stone just west of Saratoga Springs. On the west side of the Adirondacks the Theresa limestone is described by Cushing as a sandy dolomite which may in part belong to the Cambric system. It is comparatively thin and has no importance for quarry purposes.

The Beekmantown limestone, which is now taken as including the middle and upper beds of that series as earlier defined, is mostly restricted to the Champlain valley. It occurs on the New York shore in rather small areas, usually down-faulted blocks, that are the remnants of a once continuous belt. It is also represented

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doubtless in the basal portion of the limestone area that extends across Washington and Warren counties. The only place where it has been extensively quarried is at Port Henry where the purer layers have been worked for flux. In the Lake Champlain region it is a bluish or grayish magnesian limestone occurring in layers from a few inches to several feet thick.

The Chazy limestone is found in the same region as the Beekmantown in discontinuous areas along the eastern Adirondacks from Saratoga county north to the Canadian boundary. It attains its maximum thickness in eastern and northeastern Clinton county, and has been quarried around Plattsburg, Chazy and on Valcour island. The Chazy is the earliest representative of the Paleozoic formations characterized by a fairly uniform high calcium content; it analyzes 95 per cent or more of calcium carbonate. It has a grayish color and finely crystalline texture. The fossiliferous beds afford attractive polished material which is sold as "Lepanto" marble. It is used also for lime and furnace flux. There are old quarries on Willsboro point, Essex county. On the west side of the Adirondacks the Pamelia limestone described in the areal reports of that section, belong to the Chazy series. It covers a considerable area in Jefferson county between Leraysville and Clayton, and has been rather extensively quarried for building stone and lime, though of subordinate importance to the Trenton limestones of that section.

In the Mohawkian or Trenton group are included the Lowville (Birdseye), Black River and Trenton limestones which have a wide distribution and collectively rank among the very important quarry materials of the State. They are represented in the Champlain valley but are specially prominent on the Vermont side; from the latter area a belt extends southwest across northern Washington county to Glens Falls in Warren county and is continued into Saratoga county. Another belt begins in the Mohawk valley near Little Falls and extends northwesterly with gradually increasing width across Oneida, Lewis and Jefferson counties to the St Lawrence river. There are isolated areas of Trenton limestones in the Hudson valley south of Albany. The limestones vary in composition and physical character according to locality and geologic position. They are often highly fossiliferous. In the northern section they are mostly gray to nearly black in color, contain little magnesia and run as high as 97 or 98 per cent calcium carbonate. The lower part of the group is heavy bedded and well adapted for build-

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ing stone; the upper beds commonly contain more or less shale. They are used for various purposes including building and ornamental stone, crushed stone, lime, portland cement and flux. In the Champlain valley quarries are found near Plattsburg, Larabees Point and Crown Point; in Washington county at Smiths Basin; in Warren county at Glens Falls where there are extensive quarries that supply material for building purposes, portland cement and lime. The well-known black marble from Glens Falls is taken from the Trenton. Numerous quarries have been opened in Herkimer, Oneida, Lewis and Jefferson counties. The output of the last named county is specially important, including limestone for building and road construction and lime for manufacture of calcium carbide. The principal quarries in Jefferson county are at Chaumont.

The next assemblage of limestones in the order of stratigraphic occurrence includes the Clinton, Lockport and Guelph members of the Niagara group. The Clinton limestone has a variable importance in the belt of Clinton strata that extends from Otsego county a little south of the Mohawk river across the central and western parts of the State on the line of Oneida lake and Rochester to the Niagara river. East of Rochester the limestone is relatively thin, usually shaly and split up into several layers, but on the west end in Niagara county it becomes the predominant member and has a more uniform character. Large quarries have been opened recently at Pekin, Niagara county, for the supply of flux to the blast furnaces of the Lackawanna Steel Co. at Buffalo. The upper beds of bluish gray fossiliferous limestone from 10 to 12 feet thick are the purest and analyze from 90 to 95 per cent calcium carbonate. The Lockport is a magnesian limestone, in places a typical dolomite, and is rather siliceous in the lower part. It outcrops in a continuous belt, several miles wide, from Niagara Falls east to Onondaga county and then with diminishing width across Madison county. The upper layers are rather heavy and yield material suitable for building purposes, road metal and lime. There are quarries around Niagara Falls, Lockport and Rochester. It is worked to some extent in Wayne, Onondaga and Madison counties. The Guelph, also a dolomite, occupies a limited area in Monroe and Orleans counties and is worked near Rochester.

The Cayugan group includes among its members the Cobleskill, Rondout and Manlius limestones, which are economically important. They have furnished large quantities of material for the manu-

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facture of natural cement, being the source of the cement rock in the Rosendale district and in Schoharie and Onondaga counties. The cement rock of Erie county is found in the Salina formation. The purer layers are employed in Onondaga county for lime-making. The Manlius limestone is used for portland cement in the eastern part of the State.

At the base of the Devonic system appears the Helderbergian group which is very prominent for its calcareous strata. Limestones of this age are strongly developed along the Hudson river in Albany, Columbia, Greene and Ulster counties. The Coeymans or lower Pentamerus and the Becraft or upper Pentamerus limestones afford material for building, road metal, lime and portland cement. The limestone for the portland cement works at Hudson and Greenport is obtained from Becraft mountain, an isolated area of limestones belonging to the Manlius, Helderbergian and Onondaga formations. The works at Howes Cave use both the Manlius and Coeymans limestones. Extensive quarries are located also at Catskill, Rondout and South Bethlehem.

The Onondaga limestone, separated from the preceding by the Oriskany sandstone, has a very wide distribution, outcropping almost continuously from Buffalo, Erie county, eastward to Oneida county and then southeasterly into Albany county, where the belt curves to the south and continues through Greene, Ulster and Orange counties to the Delaware river. It is in most places a bluish gray, massive limestone with layers and disseminated nodules of chert. The chert is usually more abundant in the upper beds. The limestone finds use as building stone and the less siliceous material, also, for lime-making. Quarries have been opened at Kingston, Split Rock (near Syracuse), Auburn, Waterloo, Seneca Falls, Leroy, Buffalo and other places.

The Tully is the uppermost of the important limestone formations and likewise the most southerly one represented in the central part of the State. Its line of outcrop extends from Ontario to Madison county, intersecting most of the Finger Lakes. Its thickness is not over ten feet, and on that account can not be worked to advantage except under most favorable conditions of exposure. For building stone it is quarried only locally and to a very limited extent. It finds its principal use in portland cement manufacture, being employed for that purpose by the Cayuga Lake Cement Co. in its works at Portland Point, Tompkins county.

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Marl is a useful substitute for the hard limestones for some purposes and is rather extensively developed in the central and western parts of the State. It is found particularly in swampy tracts and old lake basins associated with clay and peat. In the Cowaselon swamp near Canastota the marl underlies several thousand acres and is said to be 30 feet thick. The Montezuma marshes in Cayuga and Seneca counties contain a large deposit which at Montezuma is 14 feet thick. In Steuben county the marls at Arkport and Dansville have been employed for lime-making. Until recently marls have been used extensively for portland cement and plants were operated at one time in the marl beds near Warner and Jordan, Onondaga county; at Montezuma, Cayuga county; Wayland, Steuben county; and Caledonia, Livingston county. Their principal use at present is for agricultural and chemical purposes.

Production of limestone. The limestone quarried for various uses constitutes more than one-half the total value of the quarry products of the State. The proportion would be even more in favor of limestone if the stone consumed in portland cement manufacture was reckoned in the total, but that is excluded in order to avoid duplication of the statistics.

The reports submitted by the quarry companies indicate a very large increase in the output for 1912, the total value of which amounted to $3,510,445 against a value of $3,174,161 in 1911. The advance raised the figures above those for any previous year; the next highest total was $3,300,383 in 1909. As in other branches of the industry, no account has been made of the stone quarried by contractors in connection with road improvement work, for which it is impossible to secure reliable data.

Production of limestone

MATERIAL	1910	1911	1912
Crushed stone	$1 815 809	$1 936 292	$2 176 368
Lime made	365 839	400 396	452 002
Building stone	99 049	112 082	108 581
Furnace flux	538 491	454 800	542 154
Rubble, riprap	30 819	20 328	10 696
Flagging, curbing	3 888	11 989	5 481
Miscellaneous	391 912	238 274	215 163
Total	$3 245 807	$3 174 161	$3 510 445

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Erie county outranks all others in importance in this industry; its products are chiefly furnace flux, crushed stone and building stone. The value of the limestone quarried within the county last year was $923,847. The larger quarries are at North Buffalo, Clarence and Akron.

Onondaga county occupies second place, the result mainly of the operations of the Solvay Process Co., with its quarries at Jamesville which are among the largest and best equipped of any in the country. Besides the stone used by the company in the alkali works at Syracuse, it sells a large quantity for road making, cement and other purposes. The Lackawanna Stone Co. has quarries under development which will probably enter upon active production during the current year.

The other counties reporting a value of over $100,000 in 1912 were Dutchess, Rockland, Ulster, Genesee, Warren, Niagara, Albany and Schoharie, ranking in the order named. A large quarry to furnish flux is being opened near Gasport, Niagara county. This locality lies on the outcrop of the Clinton formation, the same as the flux quarry near Pekin, a little farther west. The quarry is to be operated by the Wickwire Limestone Co. It is reported that a limestone quarry is under development at Oriskany Falls, by Bardorf, Davis & Chapman.

The distribution of the limestone according to counties and also according to uses is shown in the accompanying tables for the years 1911 and 1912.

Crushed stone. Limestone finds its principal application as crushed stone in which form it is employed for road metal, concrete and railroad ballast. There are large quarries supplying crushed stone in Erie, Genesee, Dutchess, Ulster and Rockland counties, as well as many smaller quarries in other counties. The canal, highway and other public improvements in current progress have created large markets for the material and the production has shown a steady increase. A considerable quantity of the fines made by the crushing plants is sold for agricultural purposes as a substitute for burnt rock or lime.

The value of the crushed limestone for 1912 reached a total of $2,176,368 against $1,936,292 for the preceding year. As stated already, the total does not include the stone crushed by contractors for local use on the highway system. The actual quantity turned out by the crushing plants was 3,559,257 cubic yards, as compared with 3,116,958 cubic yards in 1911. Erie county alone made an out-

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put of 958,763 cubic yards valued at $607,107. The other leading counties were Dutchess, Rockland, Ulster, Onondaga, Genesee and Albany.

Lime. The value of lime made for market last year was $452,002 as compared with $400,396 in 1911. In quantity, it amounted to 93,176 short tons. In addition there was a large output made in connection with chemical manufactures, such as alkali, carbide etc., which, as it was not sold as such, has been included under "other uses." The principal quarries for lime manufacture are in Warren, Clinton, Washington, Lewis and Jefferson counties.

Building stone. The limestones found in the State have a limited sale for building purposes, and few quarries supply more than a local demand, so that their output fluctuates greatly from year to year. The restricted market seems to be due to the fact that the limestones are prevailingly of grayish color in medium to dark tints, whereas the present demand is for white or very light gray stone such as the Bedford stone. The extending use of concrete has also been a factor in the recent decline of the cut-stone trade, though it has increased the sale of crushed stone.

The total product of building stone, according to the returns for 1912, had a value of $108,581. This was a little larger than the value for 1911 which amounted to $99,049, but considerably less than the totals reported in some of the earlier years. Erie county as usual was first in this branch of the trade; its output was valued at $67,912. Cayuga, Onondaga, Montgomery, Warren and St Lawrence counties contributed smaller amounts.

Furnace flux. The output of stone for use in blast furnaces, foundry furnaces and other metallurgical operations has assumed large proportions. For such purposes, a relatively pure material is desired, though the presence of magnesia may not be detrimental to some applications as in iron smelting. The principal quarries of flux are in the Onondaga limestone of Erie and Genesee counties and the Clinton limestones of Niagara county. Smaller amounts of flux are obtained from the Precambric crystalline limestones in St Lawrence and Essex counties, the Chazy limestone in Clinton county, and other formations.

The production of flux in 1912 was valued at $542,154, representing a total of 1,032,481 tons. The corresponding figures for the preceding year were $454,800 and in quantity 792,248 tons. Niagara county had the largest production, with Erie in second place.

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Production of limestone by counties in 1911

COUNTY	CRUSHED STONE	LIME MADE	FURNACE FLUX	BUILDING STONE	OTHER USES	TOTAL
Albany	$132 925	.....	.....	.....	.....	$132 925
Cayuga	28 494	.....	.....	$12 100	.....	40 594
Clinton	12 192	$62 002	$9 511	625	$579	84 909
Erie	489 881	300	268 082	77 689	7 663	843 615
Genesee	204 896	.....	.....	.....	.....	204 896
Greene	2 625	.....	2 000	.....	.....	4 625
Herkimer	9 283	2 603	.....	.....	.....	11 886
Jefferson	16 749	*a* 18 625	.....	.....	40 220	75 594
Lewis	2 850	35 000	.....	95	91	38 036
Madison	34 361	22 625	5 000	100	.....	62 086
Monroe	16 133	18 780	.....	3 291	994	39 198
Montgomery	39 000	.....	.....	5 338	11 184	55 522
Niagara	.....	525	141 824	800	.....	143 149
Onondaga	170 402	*a* 53	.....	10 178	190 704	371 337
Rensselaer	16 556	.....	100	.....	1 268	17 924
St Lawrence	287	6 824	24 186	652	13	31 962
Saratoga	3 792	.....	.....	.....	.....	3 792
Schoharie	19 640	300	.....	457	4 600	24 997
Seneca	5 650	22	61	487	74	6 294
Ulster	167 472	19 300	.....	.....	.....	186 772
Warren	18 161	165 064	.....	270	5 621	189 116
Washington	1 000	10 000	.....	.....	.....	11 000
Westchester	.....	21 072	253	.....	4 027	25 352
Other counties *b*	543 943	17 301	3 783	.....	3 553	568 580
Total	$1 936 292	$400 396	$454 800	$112 082	$270 591	$3 174 161

a Lime made by Solvay Process Co. and Union Carbide Co. included in "Other uses."
b Includes Columbia, Dutchess, Essex, Fulton, Oneida, Ontario, Orange and Rockland counties.

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Production of limestone by counties in 1912

COUNTY	CRUSHED STONE	LIME MADE	FURNACE FLUX	BUILDING STONE	OTHER USES	TOTAL
Albany	$136 690	.....	.....	.....	.....	$136 690
Cayuga	32 620	.....	.....	$7 330	.....	39 950
Clinton	8 694	$60 521	$13 423	600	$2 881	86 119
Erie	607 107	75	246 091	67 912	2 662	923 847
Genesee	214 310	6 750	54 557	.....	6 000	281 617
Greene	3 250	.....	6 000	.....	.....	9 250
Herkimer	14 826	.....	.....	.....	.....	14 826
Jefferson	18 865	*a* 17 942	.....	.....	.....	36 807
Lewis	1 568	35 000	.....	39	2 782	39 389
Madison	33 957	.....	.....	766	.....	34 723
Monroe	28 079	6 600	.....	2 307	.....	36 986
Montgomery	17 794	.....	.....	7 259	1 886	26 939
Niagara	.....	.....	192 915	1 407	2 800	197 122
Oneida	51 507	14 280	.....	.....	.....	65 787
Onondaga	204 998	*a*	.....	6 407	208 914	420 319
Rensselaer	23 974	.....	.....	150	.....	24 124
St Lawrence	1 035	5 277	24 612	5 149	.....	36 073
Schoharie	96 000	.....	210	2 089	1 658	99 957
Ulster	38 375	16 360	.....	.....	.....	54 735
Warren	46 434	207 727	.....	6 441	308	260 910
Washington	.....	43 350	.....	300	.....	43 650
Westchester	.....	11 695	100	.....	1 000	12 795
Other counties *b*	596 285	26 425	4 246	425	449	627 830
Total	$2 176 368	$452 002	$542 154	$108 581	$231 340	$3 510 445

a Lime made by Solvay Process Co. and Union Carbide Co. included in "Other uses."
b Includes Columbia, Dutchess, Essex, Fulton, Ontario, Orange, Rockland and Seneca counties

MARBLE

Marble, in the commercial sense, like granite, includes a variety of rocks that lend themselves to building or decorative uses. Most commonly, the name signifies a crystalline aggregate of calcite or dolomite, as distinguished from ordinary limestones which at best are of indistinctly crystalline nature. At the same time it implies the feature of attractiveness by reason of color and the ability to take a lustrous polish. Rocks possessing all these features are marbles in the strict sense to which the name may be applied without qualification. Some compact or granular limestones that lack the elements of thorough crystallinity make, however, a handsome appearance when polished, and such are commercially classed as marbles. Fossil marbles, black marbles, and a few other kinds are commonly of the noncrystalline type. Serpentine marble, or verde antique, is made up for the most part of the mineral serpentine,

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a silicate of magnesium and iron, and is therefore not related to the varieties already described. Ophitic limestone, or ophicalcite, is a crystalline limestone or dolomite carrying grains and nodules of serpentine scattered more or less evenly through its mass. Its ornamental quality lies in the speckled or mottled pattern and the sharp contrast between the clear white ground mass and the greenish serpentine inclusions.

Marbles belonging to these various types find representation in the geologic formations of the State and are quarried on a commercial scale or have been so quarried in the past.

The true or crystalline varieties are limited in occurrence to the metamorphic areas of the Adirondacks and southeastern New York. They are of early geologic age, antedating the period of crustal disturbance and metamorphism which in the Adirondacks was brought to a close practically long before Cambric time and which in southeastern New York was completed in the Paleozoic. This thoroughly crystalline character is in fact a development of the strong compression accompanied by heat to which they have been subjected; having been originally, no doubt, ordinary granular or fossiliferous limestones similar to those so plentifully represented in the undisturbed formations outside the regions.

The crystalline limestones of the Adirondacks are most abundant on the western border in Jefferson, Lewis and St Lawrence counties where they occur in belts up to 4 or 5 miles wide and several times as long, interfolded and more or less intermixed with sedimentary gneisses, schists and quartzites. They are found in smaller and more irregularly banded areas in Warren and Essex counties on the eastern side, but have little importance elsewhere. The ophitic limestones that have been quarried at different times belong to the same series. The marbles of the Adirondacks comprise both the calcite class with very little magnesia and the dolomite class containing high percentages of magnesia. No definite relation is apparent in regard to the occurrence of the two and both may be found in the same area and in close association.

The southeastern New York marbles occur in belts which follow the north-south valleys, east of the Hudson, from Manhattan island into Westchester, Dutchess and Columbia counties. They range from very coarsely crystalline to finely crystalline rocks, are prevailingly white in color and belong to the dolomite class. They are interfolded with schists and quartzites, the whole series having steep dips like those of strongly compressed strata. The geologic age

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of the southern belts is probably Precambric, but on the north and east within range of the Taconic disturbance, they may belong to the early Paleozoic.

Bodies of practically pure serpentine of considerable extent are found on Staten Island and in Westchester county near Rye; they represent intrusions of basic igneous rocks whose minerals, chiefly pyroxene and olivine, have subsequently changed to serpentine. They are not important for quarry purposes, owing to the frequency of fissures and joints and the rather somber color of the exposed parts of the masses.

The microcrystalline or subcrystalline limestones that are sometimes sold as marbles include members of the regularly bedded unmetamorphosed Paleozoic limestones, which locally, show qualities of color and polish that make them desirable for decorative purposes. They range from dense granular varieties to those having a more or less well developed crystalline texture and are often fossiliferous. Inasmuch as they have never been subjected to regional compression or been buried in the earth deep enough to become heated, the crystalline texture, when present, may be ascribed to the work of ground waters. These circulate through the mass, taking the carbonates of lime and magnesia into solution, and redeposit them in crystalline form. Originally, the limestones were accumulations of lime-secreting fossils or granular precipitates, for the most part of marine origin. Some of the localities where these unmetamorphic marbles occur are on the west shore of Lake Champlain, around Plattsburg and Chazy (Chazy limestone), Glens Falls (Trenton limestone) and Becraft mountain and Catskill (Becraft limestone).

Production. The number of active quarries in the State is small and the annual output falls below that of other quarry materials, with the single exception of granite. There is considerable fluctuation, however, in the output, depending chiefly upon the activity in building operations, as the greater part of the product is sold as architectural stone. A single contract for a large structure may make a very apparent difference in the annual total.

In 1912, there were seven active quarries, with a product valued altogether at $241,847. Nearly one-half of the value, or $114,466, was reported by three quarries in the Gouverneur district. Two quarries in southeastern New York, with one at Plattsburg and one at Glens Falls, contributed the remainder. The figures for the last three years are shown in the accompanying table.

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Production of marble

VARIETY	1910	1911	1912
Building marble	$252 965	$171 748	$155 411
Monumental	88 684	79 115	84 511
Other kinds	231	27 178	1 925
Total	$341 880	$278 041	$241 847

NOTES ON NEW YORK MARBLE QUARRIES

The marble resources of the State have been described only in a very general way, and the published information is mainly contained in the reports of the Tenth Census and Smock's bulletin on "Building Stone in New York" which reflect conditions as they existed twenty-five years or more ago. The following account of some of the developed quarries has been prepared from observations made in the summer of 1912, intended as a basis for a detailed geological, petrographical and chemical study of the subject.

Gouverneur district. The principal area of crystalline limestones with their interbedded gneisses, schists and quartzites, which together represent the Grenville series of the Adirondack region, is exposed in southwestern St Lawrence county and the contiguous part of Jefferson county in the interval between the Adirondack highland and the St Lawrence river. The area is irregular in outline, but is drawn out along a northeast-southwest direction which is the main structural trend of the region. The northeastern section in Canton and DeKalb townships, St Lawrence county, consists of a narrow belt a mile or so wide, but as it continues southwesterly into Gouverneur, it expands so as to cover most of that town and the adjoining towns of Macomb and Rossie on the north and west, narrowing at the county line and soon terminating in the towns of Antwerp and Theresa, Jefferson county. The total surface covered by this body of Grenville strata may be placed at approximately 175 square miles.

Throughout the area, the limestone is the most persistent and conspicuous member of the series, but it gives way locally to micaceous, pyritic schists, graphitic or glassy quartzites and dark hornblende gneisses and amphibolites. The several formations have the appearance of an interbedded but strongly folded, compressed and altered series of sediments. Subsequent to their folding and meta-

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morphism, they have been subjected to profound erosion so that the present surface represents what once was the deeply buried portion of the strata. As a result of these vicissitudes there is little evidence remaining of the precise structural relations presented by the complex or of the order in which the various members were originally deposited.

Intrusions of deep-seated rocks, mainly granitic in character, occur within the area. They have a more or less gneissoid appearance but not the schistosity of the Grenville gneisses, are prevailingly reddish or gray in color and belong mostly to the biotite and hornblende varieties of granite. They form bosses of some size and also sills and dikes. In their vicinity the schists and gneisses are injected by small offshoots of the granites and their pegmatites which oftentimes assume the appearance of a perfect maze of interlacing veins so that the rock is as much igneous as sedimentary in character. Besides these clearly intrusive granites and granite gneisses, there are frequent bodies of gneiss in the forms of bands and lenses which stand in indefinite relationship to the Grenville and which, like some of the gneisses on the border of the area, must await more detailed study and mapping before they can be definitely classified.

The crystalline limestone of this area constitutes one of the larger bodies of high-grade calcium limestones found in the State. It is mainly an aggregate of coarse granular calcite, white in color, holding a few included minerals like phlogopite, graphite and pyrite in scattered crystals. The average content in carbonates exceeds 90 per cent. Though it is called a calcium limestone, there is always a small amount of magnesia present — from 1 to 3 per cent — and in places it has the character of a dolomite. The change to dolomite takes place rather abruptly but apparently without reference to structural lines that might suggest original variations of deposition. The occurrence of dolomite is, however, quite local and unimportant as compared with the great body of limestone. On the other hand, the limestone shows well-marked zones or bands in which quartz and silicates are abundant and which seem to be the result of impurities included when it was being laid down. A peculiar type is represented by an admixture of white quartz and calcite in nearly equal proportions, the two minerals occurring in alternating seams, lending the appearance of a schistose rock, or else in grains and masses thoroughly intermingled. Contact effects with the intrusive granites are manifested in the development of silicate minerals like tourmaline, vesuvianite, pyroxene, tremolite

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etc., which in restricted areas become very abundant. Of valuable minerals, hematite and pyrite occur in commercial quantity, while galena, sphalerite, fluorite and barite are found in smaller bodies.

The following analyses of the limestones are based on samples from the different marble quarries, but may be said to represent the general character of the rock when fairly free of admixture. Nos. 1, 2 and 3 are by R. W. Jones, made on samples collected by the writer in 1912. No. 1 is based on sample from the extra-dark quarry of the St Lawrence Marble Quarries; no. 2, quarry of Gouverneur Marble Co; no. 3, Rylestone quarry. No. 4 is an analysis of the marble in Northern New York quarry made some years ago but not hitherto published. No. 5 represents the dolomitic marble, formerly worked by the White Crystal Marble Co.; analysis made at Watertown arsenal.

	1	2	3	4	5
Insol	3.55	1.26	1.01	.....	.....
SiO_2	.....	.....	.....	1.58	.28
Al_2O_3	.13	.65	.23	.79	.10
Fe_2O_3	.08	.29	.63		
MgO	.....	.....	.....	3.49	20.64
$MgCO_3$	6.40	7.50	6.85	7.33	.....
CaO	.....	.....	.....	51.45	31.45
$CaCO_3$	87.06	87.47	88.94	91.88	.....
H_2O	1.68	1.46	1.74	.....	.....
CO_2	.....	.....	.....	42.56	47.38
S	.05	.02	.04	.03	.06

The typical Gouverneur marbles as illustrated in the first four analyses show a very uniform composition in respect to the lime and magnesia. On the other hand, the white marble shows a much larger amount of magnesia which reaches the proportions of a dolomite.

The Gouverneur marble all comes from a small area southwest of that town; the quarries, with one or two exceptions, lie along a narrow belt which extends for a little over a mile in a northeast and southwest direction. The greater number of openings are on the eastern section. The quarries lie on the outcrop of the marble "vein" or beds which dip northwest at an angle ranging from 15° to 30° on the eastern end to 80° or 90° on the western end. Besides the dip, there is a well-marked pitch that seems to be mainly southwest at an angle of 20° or 25°. The structure resembles that of an overturned pitching fold which has undergone deep erosion.

In color and texture, the marble shows variety, though the differences are not specially prominent between the several merchantable grades of stone. It is mottled white and grayish blue, or light and

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dark blue, running in places to almost dark blue which is the color most sought for. In the lighter mottled sorts, the grain is coarse and somewhat irregular, with the light and darker calcite segregated more or less into separate areas. The individual calcite grains mostly have a diameter of about 1 or 2 mm. In the dark blue marble, however, the grain is much finer, the calcite averaging only a fraction of a millimeter in diameter. The variation in color seems to be traceable to the presence of graphitic carbon which is scattered irregularly through the mass in submicroscopic particles. The presence of carbon was indicated in the chemical analysis, but no determination of it was made, the actual amount being extremely small.

The marble is susceptible of high polish and has a luster very much like that of some gray granites. It is well adapted for monumental work and the better grades are mainly used for that purpose. Its weathering qualities are attested by nearly a century of use as monumental and building stone. For building purposes it has found considerable sale in the large towns and cities of New York and adjoining states, especially for public structures, churches and fine residences.

The rock face which is most favored for buildings has a medium gray tone, while the cut or patent hammered surface of trimmings shows much lighter. The selling prices vary with the color and uniformity, and range up to about $4.70 a cubic foot which is the price received for the best quality of extra dark monumental stock, sand rubbed but not polished. The lighter grades of monumental stone bring from $1 to $2 less a cubic foot. The grades of the different quarries do not correspond closely, so that the terms dark, extra dark, etc., as used by the several companies are not strictly equivalent.

There seems to be some relation between the color of the marble and the stratigraphic features, though such relation may not be uniform or consistent throughout the belt. In general, however, the lighter and coarser marble is on top or in the northwestern section, while the fine-grained dark comes from the structurally lower beds on the southeast. This is indicated by the variation in the different exposures and by the results of drilling.

The St Lawrence Marble Quarries. The quarries owned by this company are near the northeastern end, two of which are close to the mill and are known as the St Lawrence quarries. The third quarry, called the extra-dark, is on a different vein to the south and east. Only the last was under operation at the time of

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the writer's visit. It is an opening 125 feet long and 80 feet wide and 20 to 30 feet deep. The marble here is of medium color, mottled or veined on top, but becomes dark blue in depth which is the grade particularly sought, as the other quarries supply lighter stock of good quality. The bedding structure dips northwest 30° and pitches southwest 25°. Two vertical systems of joints intersect the beds, the one running N. 30° W. and the other N. 65° E. A trap dike from 2 to 3 feet wide crosses the quarry in the latter direction which is nearly that of the strike; it dips south at a high angle. The dike shows a serpentinous groundmass, with lath-shaped feldspars, and is probably a diabase that has been considerably weathered.

The two St Lawrence quarries near the mill are vertical rock cuts with a surface of about 20,000 square feet each and a depth in the northerly quarry of 80 feet and of 40 feet in the southerly one. They have supplied large quantities of building marble of which examples are seen in Gouverneur, Watertown, Ogdensburg, Rochester and other places. The monumental stone is mainly the selected darker quality which is sold under the trade name of "St Lawrence" but includes some lighter stone called "Adirondack." Near these quarries, a drill hole was put down which penetrated the vein for 400 feet. The dip is here about 20°.

The quarries are well equipped with six channelling machines, two gadders, and three large derricks. The mill is the largest in the district, having sixteen gangs of saws, besides rubbing beds, lathes, and polishing machines. The mill is run by electricity derived from the Hailesboro water power station.

Northern New York Marble Co. The property of the Northern New York Marble Co. lies in the southwestern section of the belt, separated from the other quarries by a long stretch of undeveloped ground. It appears to be considerably south of the course of the principal marble beds, but is possibly a continuation of the vein developed in the extra dark quarry of the St Lawrence Company. This is segregated by the similarity in the product, as well as by the relative position of the two quarries. The structural features, however, are not uniform, as the strike becomes almost east-west and the dip is very high — about 80° N. at the more westerly property. There is the same westerly pitch of the beds.

The principal quarry opening is about 140 feet long and 75 feet wide and has been worked down to 210 feet depth. This has been abandoned on account of the depth. A second quarry 100 feet south

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of the first one and about the same length has been worked to a depth of from 40 to 65 feet. In 1912, the development of a third quarry was begun, situated to the west of the latter with which it will eventually connect. This covers an area of 100 feet square. The quarries are equipped with three channelling machines, two gadders and two derricks.

The marble is mostly of the darker grades, the average being darker than that found in the other quarries, and is also finer grained. It is sold under the name of "Northern New York," with three grades depending on the relative presence or absence of lighter streaks in the dark blue ground. It is mainly in demand for monumental work. A good proportion of the lighter grade is not polished, but hammer faced, and then makes a close imitation of granite.

In the upper 15 feet, the marble shows open joints and fissures along which more or less weathering and discoloration has taken place. A few fissures reach below that depth, but for the most part the stone is uniform and quite solid. There are a few knots in the quarry walls, which arise from silicate inclusions; they rarely exceed a foot in diameter. The surface of the marble shows deep groovings from glacial erosion.

The company's mill is situated at the quarries and is equipped with ten gangs and a rubbing bed. The larger part of the output of monumental marble is shipped in polished form.

The Gouverneur Marble Co. The Gouverneur Marble Co. owns quarries on the northeastern section, adjoining those of the St Lawrence Company. Its principal development is an opening 250 feet long and nearly as wide which has been worked to an average depth of 50 feet. This is being extended by a smaller connecting quarry 125 feet long and 50 feet wide on the southeast. The beds dip northwest 10° or so and have a pitch to the northeast. The jointing is mainly in two systems N. 40° W. and N. 50° E. dividing the marble into rectangular blocks. A test hole was put down in the smaller quarry to a depth of 95 feet and is said to have shown a good quality of marble for that distance.

The product runs mostly to the medium and light sorts, but some good dark is being extracted from the more southerly section. The lighter colors are often beautifully mottled or veined. A considerable part of the product goes for building stone which is shown in churches and schools in various parts of the State.

The quarry equipment comprises a derrick, two channelers and a gadder. The mill has eleven gangs of saws.

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The Rylestone quarries. The Rylestone quarries, which were closed at the time of the writer's visit, lie a mile or so south of the main belt on a separate lead. They are situated on the side of a low hill and are not worked below the surface. The marble is a coarse medium to light stone, in which the blue and white are equally mixed. It lacks the uniformity of texture exhibited by the marble elsewhere and is subject to considerable loss in quarrying by reason of vugs that are apt to be disclosed in the midst of an otherwise sound block. These vugs range from very minute cavities lined with crystallized minerals to those a foot or two in length. Calcite, marcasite and brown tourmaline are the more common minerals found in them.

The quarry face is about 100 feet long at the base and 50 feet high. In the last operations, the stone has been quarried away by blasting. The product was sawed in a mill nearby equipped with eight gangs.

There are a number of quarry openings on the main belt which have been idle for some time, such as the Callahan quarry on the northeast end, the Sullivan quarry, near the St Lawrence quarries, and the quarry of the former Whitney Marble Co., on the southwest, near the property of the Northern New York Marble Company.

Southeastern New York. Crystalline limestone is found in the Highlands and the bordering metamorphosed area to the north and south. It is specially prominent on the east side of the Hudson, where it underlies many of the north-south stream valleys of Westchester, Putnam and eastern Dutchess counties. It is associated with schists, quartzites and thinly bedded gneisses, the whole series of interfolded metamorphosed sediments bearing much resemblance to the Grenville series of the Adirondacks. There is some doubt, however, as to the stratigraphic position that should be assigned to the limestone, if indeed it is to be regarded as an essentially continuous formation throughout the area.

In Westchester county the limestone is coarsely crystalline, white and usually dolomitic, but varying considerably in its magnesia content. The name "Inwood" limestone was first applied to it by F. J. H. Merrill, who later advocated the view of the general equivalence of the limestones in this section with those of western New England and withdrew that name in favor of the prior term "Stockbridge dolomite."

In the northern section in eastern Dutchess county, the lime-

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stone is fine in grain and shows often a bluish color, but is still prevailingly dolomitic.

The later investigations which have been carried out chiefly by Berkey indicate the possibility of the existence of two series of limestones in the region, one of which belongs to the coarser crystalline type as represented by the Westchester county rock. This is accompanied by strongly metamorphosed sandstones and argillaceous sediments known as the Lowerre quartzite and the Manhattan schist, the whole series showing no marked unconformity with the underlying gneisses. The age of the series, according to Berkey, is Precambric and may be called Grenville. The second assemblage of sediments includes the less metamorphosed representatives that are developed mainly to the north of the Highlands and include the Wappinger limestone, the Poughquag quartzite and the Hudson River slates of Cambric and Ordovicic age. Strong unconformity marks their contact with the underlying gneiss.

The limestones throughout the area are prevailingly magnesian, though they include bands and lenses that are characterized by low magnesia. In most of the developed marble quarries the stone approaches the composition of dolomite with 30 per cent or more of magnesium carbonate. The lime carbonate varies between the lower limit of 55 per cent found in the true dolomite to 70 per cent or a little more. The siliceous impurities are usually low, not over 2 or 3 per cent in the marbles. They are due to inclusions of quartz, mica, tremolite, diopside, and more rarely tourmaline. Pyrite is usually present in small amount.

The marble in this section is found in the more massive heavily bedded parts of the formation, such as are uniform in texture and nearly free of admixture with silicates. It is predominately white, either uniformly white throughout, or white clouded or banded with blue. It has been mainly used for building stone and both for exterior and interior work. There are numerous examples of it among the larger structures of New York City, especially those erected twenty or more years ago, as at that time it enjoyed greater favor among architects than any other native marble. Of recent years fashion or the exigencies of engineering technic in connection with the very large structures have brought about a change in favor of granite, limestone and terra cotta.

In durability, the marble from the different localities no doubt varies, and the ease with which some of the stone has weathered

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has caused much unfavorable comment. The tendency to rapid weathering which is announced by a roughening or pitting of the exposed surface seems to be inherent more especially in the marbles that have an even grain with the individual particles of square or rounded form. Such particles are not so well interlocked as those of prismatic shape. The weathering in most instances seems to be a mechanical process, simply a loosening of the bond through frost action or the expansion and contraction incident to changes of temperature. Normally, dolomite is harder and more resistent to the attack of solvents than calcium limestones.

South Dover Marble Co. Of the developed quarries in this section, the principal one in current operation is that of the South Dover Marble Co., situated near Wingdale, Dutchess county, a station on the Harlem Railroad. The area of crystalline limestone or marble lies on the flanks of a broad gneiss ridge which extends north and south along the New York-Connecticut boundary. The limestone shows a flat or slightly undulating surface in contrast with the rugged contours of the gneiss country. The quarries are about 2 miles in a direct line northeast of Wingdale, but somewhat over that distance by road. They are connected with the mill at the station by an electric tramway over which the large quarry blocks are transferred for cutting.

The company operates two quarries, the one being on the east slope of a low ridge facing the gneiss ridge and the second a little farther up the slope and northwest of the former. The lower quarry has an extreme length of 250 feet and a width of 150 feet in the southern half, but considerable less on the north. It is 135 feet in extreme depth. There are three derricks in place. The other opening is 150 feet long, 75 feet wide and about 60 feet deep. It has two derricks and an overhead cableway, the latter serving to convey the waste to the dump.

The marble is of medium texture, with prismatic and angular dolomite particles which measure from .75 to 1 mm. in diameter. It is practically pure white in color, and banding or veining is scarcely noticeable. The structure, as exhibited in the quarry walls, indicates an easterly dip of about 40° for the southern quarry and a westerly one of 50°–60° in the northern one, the reversal taking place in the distance of 100 feet. The marble is very compact, though in one place an open joint or water course extends to a depth of 50 feet. It shows slight exfoliation and weathering at the surface, with stained rock to a depth of 10 feet.

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There is a little pyrite in evidence, mainly collected along stringers and occasional knots of silicates. The marble seems to be delimited on the west by a hard white quartzite which forms the higher part of the ridge and is exposed 75 feet west of the quarry opening. The strike of the marble beds is a little east of north. The quartzite intervenes between these quarries and that of the Dover White Marble Co.

At the cutting works at Wingdale, the company has a complete equipment for cutting, planing and polishing its product.

The Dover White Marble Company. The Dover White Marble Co. has a quarry and mill on the east bank of Tenmile creek about one and one-half miles northwest of the quarries of the South Dover Company. The quarry is about 100 feet square and 20 feet deep on the west or downhill side and 40 feet on the east side. The marble is rather uneven in appearance, showing small bands of gray which are more pronounced in the western section and which are regarded as variations of bedding. The bands are of sericitic and quarzitic nature, derived from argillaceous and sandy layers included in the limestone. The beds strike N. 10° E. and dip 80° E. They undulate in folds and the siliceous layers are often squeezed out into lenses around which the marble has flowed under pressure. An imperfect jointing is present along the direction of the bedding. Blind checks and seams cause considerable loss in cutting. The grain is finer than that of the South Dover product, averaging less than .5 mm.

The product has been employed mainly for veneer and wainscoting. The blocks are sawed across the bedding, or horizontally, as they lie in the quarry. The company ceased active work in April 1912.

In the southern part of the region in Westchester county and the Bronx no systematic quarry operations have been carried on in several years. Some of the quarries of this section, like those at Tremont, Tuckahoe and Pleasantville, were operated at one time on a large scale for architectural stone. The marble makes a good appearance, being mostly clear white, but is very coarse grained. On that account it is not so suitable for interior or polished work as the marble from the more northerly quarries. The only use that is made of the stone at present is for lime or crushed stone.

At the Tuckahoe quarries, formerly worked by Norcross Bros., the Emerson-Norris Co., of New York, has erected a plant for

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making artificial stone, using the waste from the former operations. The marble is used with white portland cement to make a very light-colored product, or mixed with darker rock, in which case the finished material is a close imitation of granite. The stone, after casting in molds, is usually hammer dressed.

The Kapailo Manufacturing Co. has a crushing plant at the old Tuckahoe Marble Company's quarry where it makes crushed stone, sand and dust for concrete and stucco. The company has recently pumped out the quarry which it intends to operate for its uses.

SANDSTONE

Under sandstones are included the sedimentary rocks which consist essentially of quartz grains held together by some cementing substance. Among the varieties distinguished by textural features are sandstones proper, conglomerates, grits and quartzites.

Of the sedimentary rocks which occur in the State, sandstone has the largest areal distribution, while in economic importance it ranks second only to limestone. Nearly all the recognized stratigraphic divisions above the Archean contain sandstones at one or more horizons. The kinds chiefly quarried are the Potsdam, Hudson River, Medina and Devonic sandstones. A few quarries have been opened also in the Shawangunk conglomerate and the Clinton and Triassic sandstones.

The Potsdam of the Upper Cambric is the lowest and earliest in age of the sandstones that have a fairly wide distribution and are utilized for building purposes. The most extensive outcrops are along the northern and northwestern borders of the Adirondacks, in Clinton, Franklin, St Lawrence and Jefferson counties. Other exposures of smaller extent are found in the Lake Champlain valley and on the southeastern edge of the Adirondack region. These latter areas represent the remnants of a once continuous belt that has been broken up by folding, faulting and erosion. The Potsdam sandstone has in many places the character of a quartzite, consisting of quartz grains cemented by a secondary deposition of quartz, and then is a very hard, tough and durable stone. The quartzite from St Lawrence county has sustained a crushing test of more than 42,000 pounds to the square inch. The color varies from deep red to pink and white. The principal quarries are near Potsdam and Redwood, St Lawrence county, and Malone and Burke, Franklin county. Besides building stone, which is the chief product, there

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is some flagstone sold, mainly by the quarries at Burke, for shipment to Montreal.

The so-called Hudson River group is essentially a group of sandstones, shales, slates and conglomerates, ranging in age from the Trenton to the Lorraine, but which have not been sufficiently studied to permit the actual delimitation of the various members on the map. The group is exposed in a wide belt along the Hudson from Glens Falls southward into Orange county and also in the Mohawk valley as far west as Rome. The sandstone beds are usually fine-grained, of grayish color and rather thinly bedded. Over wide stretches they provide practically the only resource in constructional stone and consequently they have been quarried at a great number of places to supply the local needs for building and foundation work. Some of the stone is crushed for road metal and concrete.

The Medina sandstone is found along the southern shore of Lake Ontario from the Niagara river east to Oswego county; in central New York it is represented by a coarse conglomeratic phase called the Oneida conglomerate. As developed in the western part of the State, where it is principally quarried, it is a hard fine-grained sandstone of white, pink and variegated color. The pink variety is specially quarried for building stone and has an excellent reputation. Many of the large cities of the country and most of the important towns and cities of the State contain examples of its architectural use. The large quarries are situated in Orleans county, near Albion, Holley and Medina, along the line of the Erie canal, but there are others at Lockport and Lewiston, in Niagara county and at Brockport and Rochester in Monroe county. The Medina sandstone also finds extensive application for curbing and flagging and for paving blocks. It is employed more extensively for the latter purpose than any other stone quarried in the State.

The Shawangunk conglomerate is more widely known for its use in millstones than for constructional purposes. It outcrops along Shawungunk mountain in Ulster county and southwesterly into New Jersey, with an outlier near Cornwall, Orange county. The quarries near Otisville have supplied considerable quantities of stone for abutments and rough masonry.

The Clinton sandstone is mainly developed in central New York, being absent from the Clinton belt in the western part of the State. It forms ledges of considerable extent on the south side of the Mohawk valley from Ilion to Utica and beyond. It consists of

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reddish brown and gray sandstones, of medium texture and hardness. The stone has been used for foundations and building in Utica and other places in the vicinity.

Of the Devonic formations which cover about one-third the whole area of the State, the Hamilton, Portage, Chemung and Catskill contain important sandstone members serviceable for quarry operations. These sandstones are popularly known as bluestone, a name first applied in Ulster county where they are distinguished by a bluish gray color. They are for the most part fine-grained, evenly bedded, bluish or gray sandstones, often showing a pronounced tendency to split along planes parallel to the bedding so as to yield smooth, thin slabs. For that reason they are extensively used for flag and curbstone, and a large industry is based on the quarrying of these materials for sale in the eastern cities. Most flagstone is produced in the region along the Hudson and Delaware rivers, where there are convenient shipping facilities to New York, Philadelphia and other large cities. The Hudson River district includes Albany, Greene and Ulster counties, but the quarries are mainly situated in the area that includes southern Greene and northern Ulster, with Catskill, Saugerties and Kingston as the chief shipping points. The Delaware River district includes Sullivan, Delaware and Broome counties; the shipping stations are along the Erie and the Ontario & Western railroads. The sandstone of this section ranges from Hamilton to Catskill age. In the area to the west the quarries are confined to the Portage and Chemung groups, with the most important ones in the Portage. There are large, well-equipped quarries near Norwich, Chenango county, and Warsaw, Wyoming county, which produce building stone for the general market. Numerous small quarries are found in Otsego, Chemung, Tompkins, Tioga, Schuyler, Steuben, Yates, Allegany, Cattaraugus and Chautauqua counties.

Production of sandstone. The quarrying of sandstone is carried on by a large number of individuals and firms, more in fact than is represented in any other branch of the quarry business. Most of these operate in the bluestone districts and specially in those where flagging and curbing are the principal products. The quarrying of these materials is practically a separate industry represented by several hundred more or less independent enterprises which are usually small, giving employment to two or three workmen each and having very little in the way of mechanical equipment. A statis-

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tical canvass of such small and temporary enterprises is a matter of great difficulty and is likely to afford very unreliable results. For that reason the statistics in this report are mostly based on statements furnished by dealers who operate in the bluestone districts and who act as middlemen between the individual quarries and the larger contractors or consumers in New York and other large cities. The larger part of the curb and flagstone in the Delaware and Hudson River districts is handled by such dealers.

The production of sandstone during the last two years is shown in the accompanying tables which give its distribution also among the leading districts.

The quarries of both bluestone and ordinary sandstone were slightly more active last year than in 1911. The combined value of all the sandstone quarried was $1,280,743 against $1,060,106 in the preceding year. The gain of $220,637 or about 20 per cent. did not restore the industry to its position in the year 1910, when the value of the output amounted to $1,451,796. The totals are exclusive of any sandstone quarried by contractors for use on the State highway system, for which it is impossible to assign any accurate figure.

Of the total value of the output for 1912, bluestone constituted a little less than two-thirds, in actual figures, $824,949. In the year 1911, it had a value of $718,777, indicating a good gain, but not counterbalancing the declines of preceding years. The flagstone industry has met with increasing competition from makers of cement walks and the output has shrunk to less than half of its former proportions. The total for flag and curbstones was $503,189 against $432,327 in 1911. The value of bluestone used for building purposes was $295,450 as compared with $280,300 in 1911. The other uses are relatively unimportant.

Sandstone other than bluestone constituted a value of $455,794 against $340,729 in 1911. The main item in the total was paving blocks valued at $188,802 against $162,220. Orleans county, which is the principal center of the Medina sandstone industry, accounted for a total value of $340,796, as compared with $225,862 in the preceding year.

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Production of sandstone in 1911

DISTRICT	BUILDING STONE	CURBING AND FLAGGING	PAVING BLOCKS	CRUSHED STONE	RUBBLE RIPRAP	ALL OTHER
Bluestone						
Hudson river	$24 393	$218 216	.....	.....	$560	$200
Delaware river	31 775	204 629	.....	.....	1 775	1 245
Chenango co	72 933	9 482	.....	.....	250	1 210
Wyoming co	145 519	.....	.....	$600	910	.....
Other districts	5 680	.....	.....	.....	.....	.....
Total bluestone	$280 300	$432 327	.....	$600	$3 495	$2 655
Sandstone						
Orleans co	$21 395	$83 519	$145 575	$1 081	$4 257	$35
Other districts	25 892	10 228	16 645	22 202	6 913	2 987
Total sandstone	$47 287	$93 747	$162 220	$23 283	$11 170	$3 022
Combined total	$327 587	$526 074	$162 220	$23 883	$14 665	$5 677

Production of sandstone in 1912

DISTRICT	BUILDING STONE	CURBING AND FLAGGING	PAVING BLOCKS	CRUSHED STONE	RUBBLE RIPRAP	ALL OTHER
Bluestone						
Hudson river	$9 674	$270 544	.....	$4 000	$10 000	$1 216
Delaware river	42 944	220 601	.....	.....	5 367	997
Chenango co	85 622	4 876	.....	.....	250	2 237
Wyoming co	151 255	5 488	.....	660	483	1 100
Other districts	5 955	1 680	.....	.....	.....	.....
Total bluestone	$295 450	$503 189	.....	$4 660	$16 100	$5 550
Sandstone						
Orleans co	$35 660	$99 074	$185 432	$1 551	$6 723	$12 356
Other districts	31 945	13 583	3 370	39 090	15 930	12 080
Total sandstone	$67 605	$112 657	$188 802	$40 641	$21 653	$24 436
Combined total	$363 055	$615 846	$188 802	$45 301	$37 753	$29 986

The quarries in the Medina section were fairly active last year, favored by a good demand for materials used in street work. Curbstone and paving blocks constitute the main products of the quarries, considerably exceeding in value the building stone which once enjoyed wide popularity. These materials are marketed in Rochester, Buffalo, Cleveland and other lake cities, to which the stone

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is shipped by boat, as the barge canal passes directly through the district. For paving blocks the sandstone seems specially adapted by reason of its qualities of wearing evenly and not becoming readily rounded or "turtle-backed," which is a fault in many stone pavements. The use of blocks is superseding asphalt in paving between car tracks in city streets. There are a large number of quarries in the section from Medina to Holley, but many of these are closed at present. The tendency in the district has been toward a concentration of operations at a relatively few quarries which are well equipped and actively worked, in contrast with the small and scattered enterprises in the eastern bluestone districts.

TRAP

The quarrying of trap is a somewhat specialized branch of the stone industry which may be treated with advantage under a separate head. Trap is not a distinct rock type, but the name properly belongs to the fine-grained, dark-colored igneous rocks that occur as intrusive sheets or dikes. In mineral composition it differs from the other igneous rocks classed in the trade as granite, by the prevalence of lime-soda feldspars and higher percentages of the lime, magnesia and iron minerals and correspondingly lower amounts of silica, with little or no free quartz. The name is sometimes applied to fine-grained rocks of granite or syenitic composition and even to rocks of sedimentary derivation, but such usage is misleading and indefensible.

The particular value of trap is due mainly to its hardness and toughness. Its fine, compact homogeneous texture gives it great wearing powers and it is eminently adopted for road metal and for concrete of which heavy service is required. It has been used in this State to some extent as Belgian blocks. As a building stone it finds very little application, probably on account of its somber color. The expense of cutting and dressing trap is also an obstacle to its employment for building or ornamental purposes.

The trap quarried in New York is properly a diabase, made up of plagioclase feldspar in lath-shaped crystals and pyroxene as the main constituents, and amphibole, olivine and magnetite as subordinate minerals. The largest occurrence is represented by the Palisades of the Hudson, which begin near Haverstraw and extend southward into New Jersey. The Palisades represent the exposed edge of a sill or sheet of diabase intruded between shales and sandstones of Triassic age. The sheet is from 300 to 800 feet thick and about 70 miles long. Most of the trap quarried in this State

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has been obtained from this region, chiefly from the vicinity of Haverstraw and Nyack, but to some extent from near Richmond, Staten Island, where the sheet has its southern termination. Smaller occurrences of diabase are found in the Adirondacks and the bordering area. There are countless numbers of trap dikes in the interior of the Adirondacks, but very few have any considerable thickness and in general they are too remote from the market to be profitably quarried. In the outlying region the dikes at Greenfield, Saratoga county, and at Little Falls, Herkimer county, are the most notable. Quarries have been opened at the former locality and the trap is crushed for road material.

Production. The trap industry in Rockland county has been in an unsettled state during the past year, owing to the development of the plans for the Palisades Park. The lands to be set aside for the latter include a strip along the river that covers the more accessible part of the trap intrusions, and the abandonment of all operations in that section of Rockland county is in prospect. So far, only the property of the Manhattan Trap Rock Co., of Nyack, has been actually taken over and closed down previous to the opening of last season, but the contribution from other quarries was considerably reduced.

The value of the trap produced in 1912 was $483,863 as compared with $899,414 in 1911 and $909,006 in 1910. The whole output consisted of crushed stone, although in previous years building stone and paving blocks have also been produced to some extent. The quantity of crushed stone made was 675,309 cubic yards, of which 283,628 cubic yards, with a value of $207,957 was reported as sold for road purposes and 391,681 cubic yards valued at $275,906 for railroad ballast, concrete and other purposes. Altogether, there were six firms represented in the industry, of whom five operated in Rockland county and one in Saratoga county.

Production of trap

MATERIAL	1911		1912	
	CUBIC YARDS	VALUE	CUBIC YARDS	VALUE
Crushed stone for roads	850 322	$696 367	283 628	$207 957
Crushed stone for other purposes	267 930	199 797	391 681	275 906
Other kinds	185	3 250	.....	.....
Total	1 118 437	$899 414	675 309	$483 863

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TALC

The talc mines in the Gouverneur district were under steady operation throughout 1912 and contributed about their usual output which was shipped for the most part in ground condition for use in paper, wall plasters and other purposes. The district has supplied for some time the greater part of the ground talc produced in this country. During the last twenty years the annual outturn has ranged from 40,000 tons as a minimum to a maximum of about 70,000 tons; the total quantity mined from the first may be placed at 1,450,000 tons with a value on the average market basis of approximately $12,000,000. This very considerable item in the mineral yield of the State has not caused any serious drain upon the resources, so far as can be estimated, for the development of new mines has fairly kept pace with the depletion of supplies in the older workings while there are still many possibilities for the occurrence of additional deposits within the long stretch of territory that constitutes the district.

The principal features of the occurrence of the talc and present methods of its mining and milling were described in the preceding issue of this report. The past season has witnessed no important developments which call for any revision of the information contained in the article, except that the list of active companies was increased by the entrance of the Standard Talc Co. into the field. This company, however, did not operate a new mine, but took over the old United States mine, at Talcville, which had been under lease to the International Pulp Co. The product was shipped to New Jersey for grinding, as the mill formerly connected with the mine was burned down some time ago.

The Uniform Fibrous Talc Co. which began production in 1911 was active throughout the year, continuing the development of its mines as well as preparing for an enlarged milling capacity. The mine has been developed practically from the surface. It lies a little west of Talcville on the north bank of the Oswegatchie river. The deposit appears to be nearly in the same horizon as that worked in the United States and No. 2½ mines at Talcville. The shaft is vertical for the first 90 feet, then follows the northerly dip of the talc; at the end of 1912 it had reached a depth of a little over 200 feet. The talc body has been explored for a width of 30 feet without coming into the unaltered tremolite schist which forms the walls. It yields a very white talc of fibrous nature. An addition to the mill recently completed, provides space for the

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crushing machinery, so that the crushing and grinding can be conducted in separate rooms, a great factor in relieving the dusty conditions that are often very objectionable if not unhealthful.

The International Pulp Co., whose activity in former years was divided among a large number of mining and milling properties secured by repeated consolidations and by leaseholds, has concentrated attention recently upon a few which are more advantageously situated. The principal mines now worked are No. 2½ and No. 3 at Talcville, and the Wight mine near Sylvia lake. The operation of No. 3 mine was hampered during the last year by the loss of the water power plant at Talcville, but a new steam plant has been installed. The mine is one of the largest in the whole district, having a depth of about 500 feet on the incline and a system of levels which extends nearly double that distance along the strike. The working thickness of the body ranges from 15 to 40 feet. The Talcville mill was burned down with the power plant and only No. 6 and the Columbia mill were steadily operated.

The Ontario Talc Co., with mine and mill near Fullerville, was a steady producer.

The new developments in talc mining at Natural Bridge have been attended with much interest as the first important undertaking of the kind outside of the Gouverneur district. The property began regular shipments of talc with the completion of the mill last season; and the initial operations are reported to have been very successful, as the product proved well adapted for paper manufacture. The St Lawrence Talc Co., Inc., the owner, has already begun the enlargement of its milling capacity and continued the development of the mine. The talc from this section, as has been already mentioned in earlier reports, differs from the characteristic Gouverneur product which for the most part is of fibrous nature with subordinate amounts of foliated or scaly talc. The material at Natural Bridge, however, has a massive appearance, or at most shows an indistinctly granular habit, and is really a complex of alteration products. The color is prevailingly grayish, but there is also more or less of a greenish waxy substance intermingled with the gray talcose minerals. The green comes in part from serpentine, but mostly is referable to a chloritic mineral which has a compact massive appearance, lacking the cleavage that characterizes ordinary chlorite. Chemical analysis confirms the presence of such a mineral which may be identical with the variety called pseudophite. The apparently massive talc resolves itself under the microscope into

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an aggregate of finely divided scales which are arranged into more or less distinct groups, at times of prismatic form and again quite irregular. There is some indication of the former presence of minerals of the amphibole and pyroxene families, but just what their proportions may have been or their contribution to the present mineral association can not be stated from the little study that has been given the specimens. The vicinity of the deposits has long been a familiar locality to the mineral collector and yields quite a variety of species that are, as a whole, characteristic of the limestones when intruded and metamorphosed by deep-seated intrusives.

The production of talc by the several companies above mentioned amounted last year to 61,619 short tons, valued at $511,437. The total was a little less than that for 1911 which amounted to 65,000 short tons with a value of $552,500. The prices ranged from $8 to $9 a ton for the grades sold to the paper trade, the principal product; for the other grades they were somewhat lower.

Production of talc in New York

YEAR	SHORT TONS	VALUE	YEAR	SHORT TONS	VALUE
1881	5 000	$60 000	1897	57 009	$396 936
1882	6 000	75 000	1898	54 356	411 430
1883	6 000	75 000	1899	54 655	438 150
1884	10 000	110 000	1900	63 500	499 500
1885	10 000	110 000	1901	62 200	483 600
1886	12 000	125 000	1902	71 100	615 350
1887	15 000	160 000	1903	60 230	421 600
1888	20 000	210 000	1904	65 000	455 000
1889	23 476	244 170	1905	67 000	519 250
1890	41 354	389 196	1906	64 200	541 600
1891	53 054	493 068	1907	59 000	501 500
1892	41 925	472 485	1908	70 739	697 390
1893	36 500	337 625	1909	50 000	450 000
1894	50 500	454 500	1910	65 000	552 500
1895	40 000	320 000	1911	65 000	552 500
1896	46 089	399 443	1912	61 619	511 437

ZINC

The Northern Ore Co. continued the development of its zinc property near Edwards, but did not engage in active commercial operations. By reason of the occurrence of pyrite in much of the ore, mill treatment is essential in order to dispose of the blende to advantage. There is, moreover, considerable low-grade material

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that should pay for concentration. A mill was erected at the mines early in the year and experimental runs were made which resulted in a small output of concentrates. The milling process was based on a combination of gravity and magnetic separation without preliminary roasting, the design being to save the pyrite as well as the blende. Though experimental runs seemed to indicate the feasibility of the process, difficulty was found in carrying it out on a working scale. The mill was intended to treat 50 tons of crude ore a day.

Exploration of the ore bodies was confined mainly to the southern end of the Edwards property, on the Brown farm, where a shaft had been under way in the preceding year. This was sunk to a depth of 350 feet measured on the dip which averages perhaps 35°. Though the band or vein of ore in which the shaft started was found to pinch below, other bodies were encountered so as to afford stoping ground for most of the distance to the depth mentioned. There appeared to be little change in the character of the ore. At the 100 foot level the ore band was explored by a drift to the southwest, which, 100 feet from the shaft, came out into the surface clays that fill the adjoining valley. An adit, extended to the northwest from the drift, ran into a second band that was followed for some distance. Exploration was conducted also at depths of 200, 300 and 350 feet along the vein, constituting a series of levels from which ore will be mined when active operations are begun.

A little work was performed also a little farther north in a second shaft situated across the ridge and about 600 feet distant from the first. At this point the ore at the surface is not in a solid band of sulphides, but occurs as a zone of crushed and brecciated material in which the blende and pyrite form angular disjointed blocks with limestone as the matrix or cementing substance. The width of the zone is about 15 feet in maximum. It has been followed in the shaft to a depth of a little over 100 feet.

The work at Edwards has served naturally to stimulate interest in the mining possibilities of the region. The belt of limestones which contains the ore bodies extends southwest across the town of Edwards to Sylvia lake in the town of Fowler, a distance of about 12 miles. Recent prospecting has resulted in the discovery of additional occurrences of zinc blende at different localities within the belt. For information as to some of the occurrences not hitherto mentioned, the writer is indebted to Mr Homer L. Drake, of Gouverneur.

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The existence of zinc ore on the Balmat property, in the southwestern section near Sylvia lake, has been known since the early part of the last century and is probably the first to have been discovered in this section. The property belongs to the Northern Ore Co., but as yet has not been prospected to any extent.

A deposit that must have been known for some time but has escaped general attention occurs on the Streeter place, northeast of the Balmat. It has the form of a vein or band outcropping along the side of a low ridge which it follows apparently quite a distance. The deposit has been prospected in one place and shows a width of 4 or 5 feet. The ore resembles that at Edwards.

There is a small showing of blende on the Tamlin place, near the highway and east of the Balmat property.

Zinc blende in association with a massive or earthy hematite is found on the property of the Dominion Mining Co., near Sylvia lake. The deposit was once worked for iron ore which was used at the Fullerville furnace. The blende forms small grains which with pyrite are found in seams and nodules within the iron ore, but more specially along the contact of the iron ore and walls. The opening was pumped out and explored to some extent during the year. The company is mainly interested in talc which it has uncovered on the same property.

The existence of zinc blende is reported on the Cole place near the Potter talc mine, but has not been confirmed by the writer. Another reported occurrence that could not be confirmed is on the Sullivan place where blende and pyrite are said to have been found in the excavation for the water power development owned by the Uniform Fibrous Talc Co.

On the road from Edwards to Fullerville, about two miles southwest of the former place, there is a large outcrop of pyritic quartz schist which is very noticeable on account of the stained and burnt appearance of the ledges. On the McGill farm, nearby, crystalline limestone is exposed in several places and has been found to carry zinc blende. A prospect on a side hill south of the highway exposes a strip of the limestone about 9 feet long and 3 feet wide which is more or less charged with the sulphide. Another occurrence is found a little north of this. The limestone has not been sufficiently explored to indicate the extent of the mineralization.

It is worthy of note that the limestone in the vicinity of the sulphide bodies is always heavily charged with silicates, mainly talc and serpentine. The occurrences are usually close to some of the

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talc seams occurring nearly always on the southern or footwall side of the latter. The association of the silicates and sulphides is of considerable interest for the study of the derivation of the ores.

The zinc appears to have been introduced into its present place by underground circulations and deposited mostly as a replacement of the limestones, very little as a filling of open fissures. The view as to the secondary nature of the deposits is supported by their variable form, which ranges from narrow seams or bands to lenses and again to very irregular shapes. The seams, in places, also break across the bedding of the limestones. The horizon of the ore varies considerably within the limits of a single locality as at Edwards and in such a way as to be hardly explainable by structural disturbances of once continuous seams or beds.

That the ores have replaced the limestones is indicated by the lenticular or quite irregular forms assumed by the bodies, as above noted, by the gradation along the borders from the rich sulphides to leaner material and finally to barren limestone, and further by the absence of banding in the arrangement and of drusy cavities which characterize the fillings of open spaces. The ore body opened by the southern shaft at Edwards, however, has quite well-defined parallel walls as seen near the surface which may mark a fissured zone or channel followed by the ore-bearing solutions.

The specimens frequently exhibit nodules of talc and serpentine. These range from very small size — a fraction of an inch in diameter — up to nodules measuring a foot or more across. They are practically barren of sulphides, except such as have been fractured when the ore may be seen to extend into or across the nodules, following the seams. The nodules more often than not consist of a talc core with a surrounding shell of serpentine. The talc has a massive appearance in the hand specimens, not fibrous like the usual product of the talc mines in the vicinity; whether it has originated from alteration of tremolite or has possibly been formed directly from solutions in the period of metamorphism of the limestone can not be stated at this time. At any rate, the mineral associations indicate that the nodules, so far as represented by the talc cores, existed before the ores were deposited, though the serpentine is in part of later formation.

The serpentine which encrusts the nodules belongs to the massive variety and shows no evidence of being pseudomorphic after an anhydrous silicate. Its relations rather suggest a reaction product

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between the talc and the dolomitic limestone. Veinlets and threads of the same type of serpentine are found intersecting the sulphide bodies, the mineral here having been deposited from solution subsequent to the introduction of the ores.

Vein quartz is much in evidence around the ore bodies, specially those at Edwards; at this locality a band of white quartz 10 feet thick is exposed near the southern workings with a strike parallel to that of the ore bodies. There are numerous smaller stringers that intersect the limestone in all directions. Inclusions of talc were found in the quartz and it apparently represents a relatively late period of deposition.

The general association of the sulphides and accompanying minerals seems to bear evidence of the work of underground waters, which in an extended period of circulation through the limestones have introduced and deposited various ingredients. To the earliest stage of their activity is perhaps to be assigned the partial dolomitization and silication of the limestones which resulted in the formation of talc. It is recognized that the latter may have been derived from tremolite as is the case of most of the talc in the near-by talc district, but tremolite itself is a secondary mineral that was found either as the result of metamorphism of impure siliceous seams within the calcareous sediments or else from the reaction of silica-bearing solutions upon the limestones after their deposition and uplift. Without going into details of evidence, it may be said the latter view seems rather more probable. The underground waters next brought in iron and zinc, depositing them as sulphides in molecular interchange with the limestone. Following this, the limestones were subjected to compression which resulted in a brecciated condition, together with a certain amount of flowage, as shown in the Edwards exposures. The occurrence of quartz and serpentine stringers is to be assigned to a later period of deposition subsequent to that of the sulphides.

The compact nature of the ores, their fine granular condition and the general absence of characteristic vein types or structures, all suggest that they were deposited in their present place when the limestones were at considerable depth under cover of a heavy overburden. These conditions were undoubtedly present when the limestones underwent metamorphism and recrystallization, but that change seems to have been accomplished mostly previous to the formation of the ore bodies.

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The occurrence of vein quartz of the same character as that associated with the granites and pegmatites of the surrounding region is the only indication, so far as observed, of the possible influence of igneous agencies in the introduction of the ores. The whole area of gneisses and schists bordering the limestone belt shows frequent intrusions of granite and pegmatite,. offshoots apparently of some neighboring or underlying granite body. With the feldspathic pegmatites are found quartz veins in such relation as to indicate a common source. No close correlation in time can be made between the period of ore foundation and the invasion of the granite, but the latter can be confidently assigned to the later part of the Precambric. If the view as to the deposition of the sulphides in depth, rather than near the surface, is correct, then they also probably belong to the Precambric, as erosion has not been very marked upon the limestones since that period. The fact that the ores show effects of regional compression, though not to the same extent as their wall rocks, is a further argument in favor of a Precambric age, as there has been little disturbance of that nature in subsequent time. The intrusion of the granite, if not actually contributing to the body of underground waters, would have facilitated their circulation and added to their chemical efficiency.

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INDEX

Abrasives, 28
Acid-proof brick, 16
Adirondacks, feldspar, 26, 27; garnet, 29–31; granite, 66; graphite, 8, 31–32; iron ore, 6, 36–39; limestone, 70, 71; marble, 79, 80–87; pyrite, 52; sandstone, 91; trap, 97
Akron, limestone, 75
Akron Gypsum Co., 36
Albany, slip clay, 24
Albany county, brick, 19–20; clay industry, 17; crushed stone, 76; drain tile, 23; limestone, 73, 75, 76, 77, 78; molding sand, 59; sandstone, 93
Albany molding sand, 59
Albion, sandstone, 92
Alden-Batavia Natural Gas Co., 46
Alfred Center, clays, 14
Allegany, petroleum, 51
Allegany county, clay industry, 14, 17, 23; natural gas, 44–45, 47, 48; petroleum, 48–51; rock salt, 57; sandstone, 93; tile, 23
Allegany Pipe Line Co., 49
Alma, petroleum, 51
Aluminum, 6
American Garnet Co., 31
American Glue Co., 30
American Gypsum Co., 36
Amherst, natural gas, 46
Amsterdam, limestone, 70
Andover, natural gas, 45
Angola, clays, 14; natural gas, 46
Antwerp, marble, 81
Arkport, marl, 74
Arkwright, natural gas, 46, 48
Arnold, iron ore, 39
Attica, natural gas, 46
Auburn, limestone quarries, 73
Aurora, rock salt, 57
Ausable Forks, iron ore, 39
Avon, natural gas, 46
Baldwinsville, natural gas, 46
Ballston Springs, 41
Bardorf, Davis & Chapman, 75
Barrett Manufacturing Co., 27
Barton, H. H. & Son Co., 30
Barton Hill mines, 38
Batavia, natural gas, 46; salt, 56
Becraft limestone, 73, 80
Bedford Feldspar Co., 28, 29
Beekmantown formation, 70
Benson mines, 39
Benson Mining Co., 38
Berkey, C. P., cited, 88
Bethlehem, molding sand, 59
Birdseye limestone, 71
Black River limestone, 71
Blue Corundum Mining Co., Easton, Pa., 26
Bluestone, 63, 93, 94, 95, 96
Bolivar, petroleum, 51
Borst, C. H., 38
Bradford, Pa., petroleum, 49
Brick, 6, 9, 10, 13, 14, 15; manufacture of, 17–22; paving, 14, 15, 22; prices, 18
Bridgeport Wood Finishing Co., 29
Brighton, sand-lime brick, 63
Brockport, sandstone, 92
Brooklyn, electric supplies, 24; pottery, 24
Broome county, sandstone, 93
Buffalo, brick, 13; limestone quarries, 72, 73; natural gas, 46, 48; pottery, 24; sandstone, 95
Buffalo Natural Gas Co., 48
Buffalo Pottery Co., 24
Buffalo Sandstone Brick Co., 63
Building brick, *see* Brick
Building sand, 58, 62
Building stone, 7, 57, 63–97; from granite, 64, 65, 66; from limestone, 64, 72, 74, 75, 76; from marble, 81; from sandstone, 91, 95; from trap, 96

Digitized by Google

Building tile, 15, 16
Burke, sandstone, 91, 92
Burns, rock salt, 57
Byron, mineral waters, 42

Cairo, shale, 14
Calcium carbide, 6
Caledonia, marl, 74; natural gas, 46
Canastota, marl, 74
Canton, marble, 81
Carbon dioxid, 8, 41, 42, 44
Carbonate, 37
Carborundum, 6
Carrolton, petroleum, 51
Catskill, clays, 14; limestone, 73; marble, 80; sandstones, 93; vitrified paving brick, 22
Cattaraugus county, brick, 19; clay industry, 17; natural gas, 44, 45, 47, 48; petroleum, 51; sandstone, 93; vitrified paving brick, 22
Cayuga county, brick, 19; building stone, 76; clay industry, 17; gypsum, 34, 35; limestone, 76, 77, 78; marl, 74; rock salt, 57
Cayuga Lake Cement Co., 35, 73
Cayuga Lake Salt Co., 57
Cayugan group, 72
Cement, 7, 9, 10, 11, 12, 13
Champlain valley, limestone, 70–71, 72; marble, 80; sandstone, 91
Chas. Graham Chemical Pottery, 24
Chateaugay Ore and Iron Co., 38
Chaumont, limestone quarries, 72
Chautauqua county, brick, 19; clay industry, 14, 17; molding sand, 61; natural gas, 45, 46, 47, 48; sandstone, 93; vitrified paving brick, 22
Chazy limestone, 71, 76, 80
Cheektowaga, natural gas, 46
Cheever Iron Ore Co., 38
Chemical ware, 24
Chemung county, brick, 19; clay industry, 17; sandstone, 93
Chemung sandstone, 45, 51, 93
Chenango county, bluestone, 93, 95
China tableware, 14, 23, 24
Clarence, limestone, 75; natural gas, 46
Clarksville, petroleum, 51
Clay, 6, 13–25; crude, 9, 10, 24; products, 9, 10
Clay materials, 14–17, 22–23
Clay tobacco pipes, 24
Cleveland, sandstone products, 95
Clifton Springs, 41
Clinton, iron ore, 38
Clinton county, furnace flux, 76; lime, 76; limestone, 71, 77, 78; sandstone, 91
Clinton limestone, 72, 75, 76
Clinton sandstone, 92
Cobleskill limestone, 72
Coeymans, limestone, 73; molding sand, 59
Coke, 6
Collins, natural gas, 46
Columbia county, brick, 19, 20; clay industry, 17; limestone, 73; marble, 79; mineral waters, 42
Columbia Pipe Line Co., 49
Conduit pipes, 16
Consolidated Wheatland Plaster Co., 35
Core sand, 58, 61
Corning, clays, 14
Cornwall, sandstone, 92
Cowaselon swamp, marl, 74
Cream-colored ware, 24
Crown Point, limestone, 72
Crown Point Spar Co., 27
Crushed stone, 7; from granite, 66; from limestone, 64, 72, 74, 75; from sandstone, 95; from trap, 97
Curbing, 7; from limestone, 74; from sandstone, 92, 93, 94, 95
Cushing, H. P., cited, 70
Cuylerville, salt, 56

Dansville, marl, 74
De Kalb, marble, 81
Delac Gypsum Products Co., 35
Delaware county, sandstone, 93
Delaware river, bluestone, 93, 95
Depew, natural gas, 46
Diabase, 97
Dixon, Joseph, Crucible Co., 31
Dolomite, 70, 72

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Dominion Mining Co., 102
Dover White Marble Co., 90
Drain tile, 13, 15, 23
Drake, Homer L., 101
Dundee, rock salt, 57
Dunkirk, natural gas, 46
Dutchess county, brick, 19, 20, 22; clay industry, 16, 17; crushed stone, 75, 76; limestone, 75, 76; marble, 79, 87, 89
Dyett Sand-Lime Brick Co., 63

Earthenware, 13, 24
East Aurora, natural gas, 46
East Bloomfield, natural gas, 46
East Hamburg, natural gas, 48
Eckel, Edwin C., cited, 69
Eden valley, rock salt, 57
Edwards, zinc ores, 100, 101, 104
Electric supplies, 24
Emerson-Norris Co., 90
Emery, 9, 10, 25–26
Emery Pipe Line Co., 49
Empire China Works, Brooklyn, 24
Empire Gas & Fuel Co., 45
Empire Graphite Co., 31
Empire Gypsum Co., 35
Enamel ware, 27
Erie county, brick, 19; building stone, 76; clay industry, 14, 16, 17; core sand, 61; crushed stone, 75; fire brick and stove lining, 22; fireproofing, 23; furnace flux, 76; gypsum, 34; limestone, 73, 75, 76, 77, 78; molding sand, 61; natural gas, 45, 46, 47, 48; rock salt, 57; vitrified paving brick, 22
Essex county, furnace flux, 76; garnet, 8, 30, 31; limestone, 71, 76; marble, 79

Faillace Brothers, 68
Fayetteville Gypsum Co., 34
Feldspar, 9, 10, 14, 23, 26–29
Fire brick, 14, 15, 22
Fire clay, 24
Fire sand, 58
Fire tile, 16
Fireproofing, 6, 13, 15, 16, 23
Flagstone, 7; from limestone, 74; from sandstone, 92, 93, 94, 95
Floor tile, 23
Flue lining, 16
Flux, from limestone, 71, 72, 74, 75, 76
Fordham gneiss, 68
Fords Brook Pipe Line Co., 49
Forestville, natural gas, 46
Fort Montgomery, iron ore, 38
Fowler, pyrite, 52; zinc, 101
Franklin county, sandstone, 91
Friendship, natural gas, 45
Front brick, 15, 18
Frost Gas Co., 46, 48
Fullerville, talc, 99
Furnace flux, from limestone, 64, 71, 74, 75, 76
Furnaceville Iron Co., 38

Garbutt, gypsum, 36
Garnet, 8, 9, 10, 29–31
Gas production, 8, 44–48
Gasport, flux, 75
General Electric Co., 24
Genesee county, crushed stone, 75, 76; furnace flux, 76; gypsum, 34, 36; limestone, 75, 76, 77, 78; mineral waters, 42; natural gas, 45, 46, 47, 48, 49; salt, 55, 56
Genesee Salt Co., 57
Genesee valley, salt, 56
Geneseo, natural gas, 45
Glass sand, 57, 58, 62
Glazed brick, 27
Glen Salt Co., 57
Glens Falls, black marble, 72, 80; limestone, 72
Glens Falls Granite Brick Co., 63
Gore mountain, garnet, 30
Gouverneur, marble, 80, 81–84, 85; pyrite, 52; talc, 98
Gouverneur Marble Co., 83, 86
Gowanda, natural gas, 45; rock salt, 57
Gowanda Gas Co., 45
Graham, Chas., Chemical Pottery, 24
Granger, petroleum, 51
Granite, 6, 7, 9, 10, 64, 65–69

Digitized by Google

Graphite, 8, 9, 10, 31–32
Gravel, 9, 10, 57, 58
Greater New York Brick Co., 21
Green Ridge, clays, 14
Greene county, brick, 19, 20; clay industry, 17; limestone, 73, 77, 78; sandstone, 93
Greenfield, graphite, 32; trap, 97
Greenport, limestone, 73
Grove, petroleum, 51
Guelph dolomite, 72
Gypsum, 7, 9, 10, 33–36

Hamilton shales, 93
Harmony mines, 38
Haverstraw, trap, 97
Helderberg limestone, 73
Hematites, 37, 38, 102
Herkimer county, limestone, 72, 77, 78; trap, 97
Highlands, granite, 66; iron ore, 39
Hinckley Fibre Co., 52
Holley, sandstone, 92
Hollow brick, 13, 23
Honeoye Falls, natural gas, 46
Hornell, natural gas, 45
Howes Cave, limestone, 73
Hoyt limestone, 70
Hudson, limestone, 73
Hudson Iron Co., 38, 39
Hudson River group, 92
Hudson River region, bluestone, 95; building brick, 15, 18, 20; clays, 14; granite, 66; iron ore, 39; limestones, 71; marble, 87–91; molding sand, 57, 59–60; sandstone, 92, 93, 95; trap, 96
Hudson River slates, 88

International Pulp Co., 98, 99
International Salt Co., 57
Inwood limestone, 87
Iron ore, 6, 9, 10, 36–40
Iroquois China Co., 24
Iroquois Gas Co., 48
Ithaca Salt Co., 57

Jamestown, clays, 14
Jamesville, gypsum, 34; limestone quarry, 75; portland cement, 12
Jefferson county, clay industry, 17; lime, 76; limestone, 71, 72, 76, 77, 78; marble, 79, 81; sandstone, 91
Jewettville, clays, 14
Jordan, marl, 74
Joseph Dixon Crucible Co., 31

Kaolin, 14
Kapailo Manufacturing Co., 91
Keeseville, garnet, 31
Kemp, James F., bulletin by, 44
Kendall Refining Co., 49
Kensico, granite, 67–68
Keystone Emery Mills, Frankford, Pa., 26
Kings county, clay industry, 16, 17; fire brick and stove lining, 22; fireproofing, 23; tile, 23
Kings Station, graphite, 32
Kingston, limestone, 73; sandstone, 93
Kingston Iron Ore Co., 39
Kinkel, P. H., Sons, 28, 29
Kreischerville, clays, 14

Lackawanna Steel Co., 72
Lackawanna Stone Co., 75
Lake Albany, glacial, 59
Lakeville, iron ore, 38
Lancaster, natural gas, 46; sand-lime brick, 63
Land plaster, 34
Larabees Point, limestone quarries, 72
Larchmont, granite, 69
Lebanon Springs, 41, 42
Lepanto marble, 71
Leroy, limestone quarries, 73; natural gas, 46; salt, 56
Le Roy Salt Co., 57
Lewis county, granite, 69; lime, 76; limestone, 71, 72, 76, 77, 78; marble, 79
Lewiston, sandstone, 92
Lima, electric supplies, 24; natural gas, 46
Lime, 71, 72, 73, 74, 76
Limestone, 6, 9, 10, 63, 64, 65, 70–78; analyses, 83
Limonite, 37
Little Falls, trap, 97

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Little Falls dolomite, 70
Livingston county, brick, 19; clay industry, 17; marl, 74; natural gas, 45, 46, 47; petroleum, 51; salt, 7, 55, 56
Locke Insulator Co., 24
Lockport, limestone, 72; sandstone, 92
Long Island, clays, 14; glass sand, 62
Lowerre quartzite, 88
Lowville limestone, 71
Ludlowville, salt, 57
Lycoming Calcining Co., 35
Lyndon, gypsum, 34
Lyon Mountain, iron ore, 38

Macomb, marble, 81
Madison county, gypsum, 34; limestone, 72, 77, 78; salt, 56
Magnetite, 6, 37, 38, 39
Malone, sandstone, 91
Mamaroneck, granite, 68–69
Manhattan schist, 88
Manhattan Trap Rock Co., 97
Manlius limestone, 72, 73
Marble, 7, 9, 10, 64, 65, 72, 78–91; analyses, 83
Marcellus formation, 45
Marl, 74
Massena Springs, 42
Medina sandstone, 45, 46, 91, 92, 94
Merrill, F. J. H., cited, 87
Metallic paint, 9, 10
Millen Portland Cement Co., 12
Millstones, 9, 10
Mineral production, 5, 9, 10
Mineral waters, 9, 10, 40–44
Minerva, garnet, 30
Mineville, iron ore, 38
Mohawk valley, dolomite, 70; limestone, 71; sandstone, 92
Mohegan Granite Co., 67
Molding sand, 57, 58, 59–61
Monroe county, brick, 19; clay industry, 17; fireproofing, 23; gypsum, 34, 35, 36; limestone, 72, 77, 78; natural gas, 45; sandstone, 92; sewer pipe, 23; tile, 23
Montezuma marshes, marl, 74
Montgomery county, brick, 19; building stone, 76; clay industry, 17; limestone, 76, 77, 78
Monumental stone, 7, 66, 81
Morrisville, salt, 56
Mt Bigelow, garnet, 31
Mt Pokamoonshine, garnet, 31
Mt Summit Ore Corporation, 39
Mumford, gypsum, 35

Naples, rock salt, 57
Nassau county, brick, 19; building sand, 62; clay industry, 17
National Salt Co., 57
Natural Bridge, talc, 99
Natural gas, 7, 8, 9, 10, 44–48
Natural rock cement, 7, 9, 10, 11, 12, 73
New York county, clay industry, 17; fireproofing, 23
New York Transit Co., 49
Newstead, natural gas, 46
Niagara county, brick, 19; clay industry, 17; furnace flux, 76; limestone, 72, 75, 76, 77, 78; natural gas, 45, 47; sandstone, 92
Niagara Falls, limestone, 72
Norcross Bros., 90
North Buffalo, limestone, 75
North Collins, natural gas, 46
North River Garnet Co., 30
Northern New York Marble Co., 85–86, 87
Northern Ore Co., 100, 102
Norwich, sandstone, 93
Nyack, trap, 97

Oak Orchard springs, 42
Oakfield, gypsum, 36
Oatka creek, salt, 56
Oatka Gypsum Co., 35
Ogdensburg, marble, 85
Oil, 8, 48–51
Oil City, Pa., natural gas, 45
Old Bed mines, 38
Olean, natural gas, 45; petroleum, 49, 51
Oneida conglomerate, 92

Digitized by Google

Oneida county, brick, 19; clay industry, 17; core sand, 61; fireproofing, 23; glass sand, 62; limestones, 71, 72, 73, 78
Onondaga Coarse Salt Association, 56
Onondaga county, brick, 19; building stone, 76; cement, 12; clay industry, 16, 17; crushed stone, 76; gypsum, 34; limestone, 72, 73, 75, 76, 77, 78; marl, 74; natural gas, 45, 46, 47; salt industry, 54, 55, 56; stoneware clays, 25
Onondaga limestone, 45, 73, 76
Onondaga Pottery Co., 23
Ontario Center, iron ore, 38
Ontario county, brick, 19; clay industry, 17; mineral waters, 42; natural gas, 45, 46, 47; rock salt, 57
Ontario Iron Ore Co., 38
Ontario Talc Co., 99
Opalescent glass, 27
Orange county, brick, 19, 20, 22; clay industry, 16, 17; limestone, 73; sandstone, 92
Orchard Park, natural gas, 48
Oriskany Falls, limestone, 75
Oriskany sandstone, 73
Orleans county, limestone, 72; sandstone, 92, 94, 95
Ornamental stone, 72
Oswegatchie river, iron ore, 39; talc, 98
Oswego county, natural gas, 45, 46, 47
Otisville, sandstone, 92
Otsego county, sandstone, 93

Palisades, trap, 96
Palisades Park, 97
Pamelia limestone, 71
Paragon Plaster Co., 63
Pass and Seymour, 24
Pavilion Natural Gas Co., 46
Paving blocks, sandstone, 92, 94, 95, 96
Paving brick, 14, 15, 22
Peekskill, emery, 25; granite, 67
Pekin, quarries, 72, 75
Perry, rock salt, 57
Petroleum, 7, 9, 10, 48–51
Phoenix, natural gas, 46
Piffard, salt, 57
Pig iron, 6
Plattsburg, limestone, 71, 72; marble, 80
Porcelain, 14, 23, 24
Port Henry, iron ore, 38; limestone, 71
Port Henry Iron Ore Co., 38
Port Jefferson, sand-lime brick, 63
Portage sandstone, 45, 93
Portland cement, 7, 9, 10, 11, 12, 72, 73, 74
Portland Point, 35, 73
Potsdam sandstone, 91
Pottery, 6, 9, 10, 15, 16, 23–24
Poughquag quartzite, 88
Producers Gas Co., 45
Pulaski, natural gas, 47
Putnam county, iron ore, 39; marble, 87
Pyrite, 8, 9, 10, 52

Quarry materials, value of, 6
Quartz, 9, 10, 14, 23
Queens county, clay industry, 17; terra cotta, 23

Red earthenware, 24
Red House, natural gas, 48
Redwood, sandstone, 91
Remington Salt Co., 57
Rensselaer county, brick, 19, 20; clay industry, 17; fire brick and stove lining, 22; fireproofing, 23; limestone, 77, 78
Retsof, salt, 56
Retsof Mining Co., 57
Richburg, petroleum, 51
Richfield Springs, 41
Richmond, trap, 97
Richmond county, brick, 19; clay industry, 17; fire brick and stove lining, 22; terra cotta, 23
Riparius, garnet, 30
Riprap, from granite, 66; from limestone, 74; from sandstone, 95
Road metal, limestone, 73; trap, 96. *See also* Crushed stone
Rochester, brick, 13; limestone, 72; marble, 85; petroleum, 49; sandstone, 92, 95

Digitized by Google

Rochester Composite Brick Co., 63
Rock Glen, salt, 56, 57
Rock Glen Salt Co., 57
Rock salt, 53, 54, 55, 56, 57
Rockland county, brick, 19, 20, 22; clay industry, 16, 17; crushed stone, 75, 76; limestone, 75, 76; trap, 97
Rondout, quarry, 73
Rondout limestone, 72
Roofing material, use of feldspar, 26
Roofing slate, 9, 10
Roofing tile, 23
Rosendale cement, 12, 73
Rossie, marble, 81
Rubble, from granite, 66; from limestone, 74; from sandstone, 95
Rudiger Brothers, 67
Rye, marble, 80
Rylestone, marble quarries, 83, 87

St Lawrence county, building stone, 76; furnace flux, 76; limestones, 76, 77, 78; marble, 79, 81–86; mineral waters, 42; pyrite, 8, 52; sandstone, 91; talc, 8; zinc, 100
St Lawrence Marble Quarries, 83, 84, 85
St Lawrence Pyrite Co., 52
St Lawrence Talc Co., 99
Salina limestone, 56, 73
Salisbury Steel & Iron Co., 38
Salt, 7, 9, 10, 53–57
Sand, 9, 10, 57–62
Sand-lime brick, 9, 10, 62–63
Sandstone, 7, 9, 10, 63, 64, 65, 91–96
Sandstone Brick Co., 63
Sandy Creek, natural gas, 47
Sanitary wares, 24
Saratoga county, brick, 19; clay industry, 17; graphite, 32; limestone, 70, 71, 77; trap, 97
Saratoga Graphite Co., 32
Saratoga Springs, 8, 41, 44, 70
Saugerties, sandstone, 93
Schenectady, electric supplies, 24; sand-lime brick, 63
Schenectady county, clay industry, 16, 17
Schoharie county, limestone, 73, 75, 77, 78
Schuyler county, natural gas, 45, 47; salt, 55, 57; sandstone, 93
Scio, petroleum, 51
Seneca, petroleum, 51
Seneca county, limestone, 77; marl, 74; natural gas, 45, 47; rock salt, 57
Seneca Falls, limestone quarries, 73; rock salt, 57
Severance, quarry, 34
Sewer pipe, 15, 23
Sharon Springs, 41
Shawangunk conglomerates, 91, 92
Sheridan, natural gas, 46
Silver Creek, natural gas, 46, 48
Silver Creek Gas & Improvement Co., 46
Silver Springs, salt, 57
Slate, 9, 10
Slate pigment, 9, 10
Slip clay, 23, 24
Smith's Basin, limestone, 72
Soda products, 6
Solvay, salt, 57
Solvay Process Co., 13, 54, 57, 75, 77, 78
South Bethlehem, quarry, 73
South Dover Marble Co., 89, 90
South Shore Gas Co., 46
Split Rock, limestone quarries, 73
Spring waters, 40–44
Springville, natural gas, 46; rock salt, 57
Standard Talc Co., 98
Staten Island, clays, 14, 24; marble, 80; trap, 97
Steel, manufacture, 6
Stellaville, pyrite, 52
Sterling Iron and Railway Co., 38, 39
Sterling Salt Co., 57
Steuben county, brick, 19; clay industry, 14, 17; marl, 74; natural gas, 45, 47; petroleum, 51; sandstone, 93; terra cotta, 23; vitrified paving brick, 22
Stockbridge dolomite, 87
Stoller, J. H., cited, 60
Stone, 7, 63–97
Stoneware, 14, 23, 24, 25
Stove lining, 15, 22
Stucco, 33, 34

Digitized by Google

Suffolk county, brick, 19; clay industry, 17
Sullivan county, sandstone, 93
Swain, petroleum, 51
Sylvia lake, zinc, 101, 102
Syracuse, brick, 13; clay, 13; electric supplies, 24; potteries, 16, 24; salt, 54, 56; sand-lime brick, 63

Tablewares, 23, 24
Talc, 8, 9, 10, 98–100
Talcville, 98, 99
Terra cotta, 6, 14, 15, 16, 23, 27
Terra cotta tile, 23
Theresa, marble, 81
Theresa limestone, 70
Ticonderoga, feldspar, 27
Tidewater Brick Co., 22
Tide Water Pipe Co., 49
Tile, 14, 15, 16, 23
Tioga county, sandstone, 93
Tobacco pipes, 24
Tompkins county, limestone, 73; salt, 55, 57; sandstone, 93
Tonawanda, natural gas, 46
Trap, 7, 9, 10, 64, 65, 96–97
Trenton limestone, 45, 46, 71, 80
Tuckahoe, quarries, 90
Tuckahoe Marble Co., 91
Tully, salt, 54, 57
Tully limestone, 73

Ulster county, bluestone, 93; brick, 19, 20, 22; cement, 12; clay industry, 16, 17; crushed stone, 75, 76; limestone, 73, 75, 76, 77, 78; sandstone, 92, 93
Uniform Fibrous Talc Co., 98, 102
Union Carbide Co., 77, 78
Union Pipe Line Co., 49
Union Porcelain Works, Brooklyn, 24
Union Springs, gypsum, 35
United Natural Gas Co., 45, 46, 48
United States Gypsum Co., 36

Vacuum Oil Co., 49
Valcour island, limestone, 71
Victor, electric supplies, 24
Vincent, rock salt, 57
Vitrified paving brick, 15, 22

Wall plaster, 33, 34
Wappinger limestone, 88
Warner, marl, 74
Warren county, brick, 19; building stone, 76; clay industry, 17; garnet, 8, 30; lime, 76; limestone, 71, 72, 75, 76, 77, 78; marble, 79
Warren County Garnet Mills, 30
Warsaw, salt, 56; sandstone, 93
Washington county, clay industry, 17; fire brick and stove lining, 22; lime, 76; limestone, 71, 72, 76, 77, 78
Waterloo, limestone quarries, 73
Watertown, marble, 85
Watkins Salt Co., 57
Wayland, marl, 74
Wayne county, limestone, 72
Weber Electric Co., 24
Welch Gas Co., 46
Wellsville, natural gas, 45; petroleum, 49
West Bloomfield, natural gas, 46
West Union, petroleum, 51
Westchester county, brick, 19, 20; clay industry, 17; fire brick and stove lining, 22; granite, 66; limestone, 77, 78; marble, 79, 80, 87, 88, 90
Westfield natural gas, 46
Wevertown, garnet, 30
White Crystal Marble Co., 83
Whitney Marble Co., 87
Wickwire Limestone Co., 75
Willsboro point, quarry, 71
Wingdale, marble, 89, 90
Wirt, petroleum, 51
Witherbee, Sherman & Co., 38
Worcester Salt Co., 57
Wyoming, salt, 56
Wyoming county, bluestone, 95; natural gas, 45, 46, 47; salt, 55, 56; sandstone, 93, 95

Yates county, natural gas, 45, 47; rock salt, 57; sandstone, 93
Yonkers gneiss, 67

Zinc, 100–5
Zinc blende, 102

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New York State Education Department

New York State Museum

JOHN M. CLARKE, Director

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5 Entomology	59 Entomology	114 Geology
6 "	60 Zoology	115 "
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9 Zoology	63 Geology	118 Geology
10 Economic Geology	64 Entomology	119 Economic Geology
11 "	65 Paleontology	120 "
12 "	66 Miscellaneous	121 Director's report for 1907
13 Entomology	67 Botany	122 Botany
14 Geology	68 Entomology	123 Economic Geology
15 Economic Geology	69 Paleontology	124 Entomology
16 Archeology	70 Mineralogy	125 Archeology
17 Economic Geology	71 Zoology	126 Geology
18 Archeology	72 Entomology	127 "
19 Geology	73 Archeology	128 "
20 Entomology	74 Entomology	129 Entomology
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39 Paleontology	93 Economic Geology	148 Geology
40 Zoology	94 Botany	149 Director's report for 1910
41 Archeology	95 Geology	150 Botany
42 Geology	96 "	151 Economic Geology
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47 "	101 Paleontology	156 "
48 Geology	102 Economic Geology	157 Botan
49 Paleontology	103 Entomology	158 Director's report for 1911
50 Archeology	104 "	159 Geology
51 Zoology	105 Botany	160 "
52 Paleontology	106 Geology	161 Economic Geology
53 Entomology	107 Geology and Paleontology	162 Geology
54 Botany	108 Archeology	163 Archeology
	109 Entomology	164 Director's report for 1912

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Bulletin	*Report*	*Bulletin*	*Report*	*Bulletin*	*Report*	*Bulletin*	*Report*
12–15	48, v. 1	78	57, v. 2	116	60, v. 1	150	64, v. 2
16, 17	50, v. 1	79	57, v. 1, pt 2	117	60, v. 3	151	64, v. 2
18, 19	51, v. 1	80	57, v. 1, pt 1	118	60, v. 1	152	64, v. 2
20–25	52, v. 1	81, 82	58, v. 3	119–21	61, v. 1	153	64, v. 2
26–31	53, v. 1	83, 84	58, v. 1	122	61, v. 2	154	64, v. 2
32–34	54, v. 1	85	58, v. 2	123	61, v. 1	155	65, v. 2
35, 36	54, v. 2	86	58, v. 5	124	61, v. 2	156	65, v. 2
37–44	54, v. 3	87–89	58, v. 4	125	62, v. 3	157	65, v. 2
45–48	54, v. 4	90	58, v. 3	126–28	62, v. 1	158	65, v. 1
49–54	55, v. 1	91	58, v. 4	129	62, v. 2	159	65, v. 1
55	56, v. 4	92	58, v. 3	130	62, v. 3	160	65, v. 1
56	56, v. 1	93	58, v. 2	131, 132	62, v. 2	161	65, v. 2
57	56, v. 3	94	58, v. 4	133	62, v. 1	162	65, v. 1
58	56, v. 1	95, 96	58, v. 1	134	62, v. 2		
59, 60	56, v. 3	97	58, v. 5	135	63, v. 1	*Memoir*	
61	56, v. 1	98, 99	59, v. 2	136	63, v. 2	2	49, v. 3
62	56, v. 4	100	59, v. 1	137	63, v. 1	3, 4	53, v. 2
63	56, v. 2	101	59, v. 2	138	63, v. 1	5, 6	57, v. 3
64	56, v. 3	102	59, v. 1	139	63, v. 2	7	57, v. 4
65	56, v. 2	103–5	59, v. 2	140	63, v. 1	8, pt 1	59, v. 3
66, 67	56, v. 4	106	59, v. 1	141	63, v. 2	8, pt 2	59, v. 4
68	56, v. 3	107	60, v. 2	142	63, v. 2	9, pt 1	60, v. 4
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70, 71	57, v. 1, pt 1	109, 110	60, v. 1	144	64, v. 2	10	60, v. 5
72	57, v. 1, pt 2	111	60, v. 2	145	64, v. 1	11	61, v. 3
73	57, v. 2	112	60, v. 1	146	64, v. 1	12	63, v. 3
74	57, v. 1, pt 2	113	60, v. 3	147	64, v. 2	13	63, v. 4
75	57, v. 2	114	60, v. 1	148	64, v. 2	14, v. 1	65, v. 3
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46 —— Scale Insects of Importance and a List of the Species in New York State. 94p. il 15pl. June 1901. 25c.
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—— & Clarke, John M. v. 8 pt 1 Introduction to the Study of the Genera of the Paleozoic Brachiopoda. 16 + 367p. 44pl. 1892. $2.50.
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Catalogue of the Cabinet of Natural History of the State of New York and of the Historical and Antiquarian Collection annexed thereto. 242p. 8vo. 1853.

Handbooks 1893–date.

New York State Museum. 52p. il. 1902. Free.
Outlines, history and work of the museum with list of staff 1902.

Paleontology. 12p. 1899. *Out of print.*
Brief outline of State Museum work in paleontology under heads: Definition; Relation to biology; Relation to stratigraphy; History of paleontology in New York.

Guide to Excursions in the Fossiliferous Rocks of New York. 124p. 1899. *Out of print.*
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Classification of New York Series of Geologic Formations. 32p. 1903. *Out of print.* Revised edition. 96p. 1912. Free.

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Geologic maps. Merrill, F. J. H. Economic and Geologic Map of the State of New York; issued as part of Museum Bulletin 15 and 48th Museum Report, v. 1. 59 x 67 cm. 1894. Scale 14 miles to 1 inch. 15c.

—— Map of the State of New York Showing the Location of Quarries of Stone Used for Building and Road Metal. 1897. *Out of print.*

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